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ASTM BULLETIN

Published by

AMERICAN SOCIETY for TESTING MATERIALS

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AUGUST—1947

No. 147

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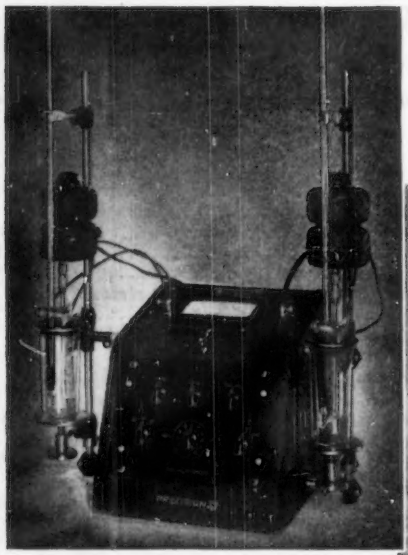

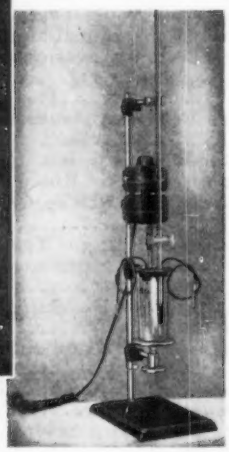

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ASTM BULLETIN

"Promotion of Knowledge of Materials of Engineering, and Standardization of Specifications and Methods of Testing"

TELEPHONE—Rittenhouse 6-5315 | R. E. Hess, Editor
R. J. Painter, Associate Editor | CABLE ADDRESS—TESTING

Number 147 | August 1947

Much Accomplished at Fiftieth Annual Meeting

350 Committee Meetings, 19 Technical Sessions, Other Events Make Full Week

THE PROBLEM of indicating just which features of an Annual Meeting of the Society are outstanding is fraught with difficulties because the technical session or series of committee meetings that may be of unusual importance to one group, say in the field of ferrous metals, may be only of passing interest to the group concerned with rubber testing or petroleum products, and *vice versa*. The Society's Fiftieth Annual Meeting at Chalfonte-Haddon Hall, in Atlantic City, was notable in many respects—for the 350 technical committee meetings held and for technical symposiums including those on Rubber Testing, the Load Test for the Bearing Capacity of Soils, and two of specific interest to the petroleum field, one on Electrical Insulating Oils, and the other on Synthetic Lubricants. The Symposium on Measurement of Entrained Air in Concrete was of special interest to those who produce and use cement and concrete in the various construction applications. There were many other significant sessions, the one devoted to Plastic Deformation of Metals carrying over into an overtime meeting.

Some notes on features of the technical program appear in portions of this article which follow. All of the papers and reports will be published, most in *Proceedings* or BULLETIN but decision will be conveyed later to the membership on whether all of the symposiums and some of the collections of technical papers are to appear in the *Proceedings* or as special publications.

Elsewhere in this BULLETIN is a separate article dealing with standardization activities in prospect, the news material being based on information appearing in the current reports of committees or furnished by committee officers as part of their programs of work.

ACTIONS ON STANDARDS

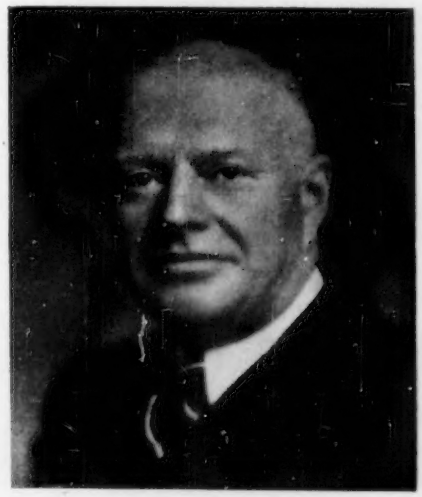
It will be noted from the accompanying table giving a summary of actions taken at the Annual Meeting that about 43 new tentative specifications and tests were approved, and that upwards of 70 existing tentatives are to be referred to letter ballot of the Society for adoption as formal standards. Many existing tentatives and full standards were revised. Details of the various actions and recommendations appeared in the reports of committees, and a Summary of Proceedings which will accompany the Society letter ballot to be distributed in July will detail additional actions taken at the meeting which were not covered in the reports.

In connection with the A.S.T.M. work on standards, President Carpenter in his annual address pointed out that it was not until about 1915 that the Society had surpassed the 100 mark and that by 1930 the total number of specifications and

New President

T. A. Boyd

New Vice-President



J. G. Morrow

Head Table at the Annual Meeting Dinner. From l. to r.: J. F. Vogdes, Jr., Chairman, Philadelphia District Council; R. L. Templin, Aluminum Company of America, A.S.T.M. Vice-President; H. F. Moore, University of Illinois, A.S.T.M. Past-President and Honorary Member; P. H. Bates, Retired, A.S.T.M. Past-President; Dr. A. C. Fieldner, U. S. Bureau of Mines, A.S.T.M. Past-President and New Honorary Member; G. H. Clamer, Ajax Metal Co., A.S.T.M. Past-President and Honorary Member; T. A. Boyd, General Motors Corp., A.S.T.M. President.

tests was over 500. It took 30 years to develop 500 standards, 10 years for the next 500, but only about 6 years for the most recent 500, indicating a much faster rate as far as standardization activities are concerned in the technical committees. He went on to stress the fact that mere numbers were not of particular interest but the widespread acceptance of the standards was the significant factor.

New Officers

Results of the letter ballot on election of new officers were announced at the Dinner by the Chairman of the Tellers' Committee, A. O. Schaefer. The five newly elected members of the Board of Directors and the newly appointed member were introduced, and President Carpenter also introduced the new Vice-President, J. G. Morrow, of The Steel Company of Canada, Ltd., and the new President, T. A. Boyd, General Motors Corp., these two men responding appropriately. Photographs of the new officers and biographical material appear elsewhere in this article.

A.S.T.M. Dinner

Under the sponsorship of the Philadelphia District an Annual Dinner was held, at which newly elected officers were introduced, Honorary Memberships awarded, and the President's address and a guest address were presented. Forty-year Memberships were also recognized. About 300 were in attendance.

The President's address is printed elsewhere in this Bulletin. It will be noted that Mr. Carpenter took special cognizance of the fact that this was the Fiftieth Annual Meeting of the Society. He reviewed briefly the history of the Society, mentioning some of the earlier events on which the A.S.T.M. activities were based, and referred to a number of men who did so much to aid in establishing the Society's activities on a firm foundation.

The guest speaker, Dr. Roy K. Marshall, Director of the Franklin Institute's Fels Planetarium and science editor of The Philadelphia Evening *Bulletin*, gave a thought-provoking talk on "Materials Problems in the Atomic Age." He stressed the relative rapidity with which technical developments were occurring and pointed out that proper materials are really the crux of just how fast atomic energy can be harnessed for man's peacetime uses.

Award of Medals

There was no award of the Charles B. Dudley Medal this year, the Committee on Awards after detailed review of the technical papers recommending that the Award be passed on the basis of the 1946 papers. However, two of the more special awards were made: the Richard L. Templin Award, which was given for meritorious efforts in connection with the development of testing methods and apparatus, going to F. B. Quinlan, Metallurgical Section of Works Laboratory, General Electric Co., Schenectady, N. Y., for his paper "Pneumatic Fatigue Machines," a part of the Symposium on Parts and Assemblies; and the Sanford E. Thompson Award, sponsored by Committee C-9, which recognizes a paper of outstanding merit on concrete and concrete aggregates, given to William Lerch, Manager, Department of Applied Research of the Portland Cement Association, Chicago, for his paper on "The Influence of Gypsum on the Hydration and Properties of Portland Cement Pastes."

Photographs of Messrs. Lerch and Quinlan and brief biographical material are given on page 16.

Marburg Lecture

A notable 21st Edgar Marburg Lecture was presented by Professor Walter C. Voss, Head, Department of Building Engineering and Construction, Massachusetts Institute of Technology, on the subject "Fundamentals Underlying the Problems of the Inhomogeneity of Engineering Laminates." The Lecture was prefaced by one of Bernard Shaw's inimitable statements: "Science is always wrong. It never solves a problem without creating ten more." The Lecturer pointed out that much of the research we get under way is initiated by some group which needs to know whether a particular material or assemblage will do a specific job. Frequently, however, the results may point to the fact that some basic fundamentals were unknown, and if these could be set forth more clearly the research could be guided more directly. He stated that "The classic approach to research involves certain very well-defined steps. These steps are: (a) survey of existing directly and indirectly related work, (b) correlation and study of such data for the purpose of formulating certain hypotheses, (c) the setting up of definite hypotheses, (d) testing

Head Table *(continued)*. From l. to r.: Arthur W. Carpenter, B. F. Goodrich Co., A.S.T.M. Past-President; W. H. Fulweiler, Past-President, Honorary Member, Toastmaster; Guest Speaker, Dr. Roy K. Marshall, Franklin Institute; F. M. Farmer, Electrical Testing Labs., Inc., Past-President and New Honorary Member; J. R. Townsend, Bell Telephone Labs., Inc., Past-President; J. G. Morrow, Steel Company of Canada, Ltd., New Vice-President; H. S. Vassar, Public Service Electric and Gas Co., Past-President and New Honorary Member; Dean Harvey, Retired, Past-President; Professor W. C. Voss, Massachusetts Institute of Technology, Marburg Lecturer; C. L. Warwick, Executive Secretary, American Society for Testing Materials.

these hypotheses, (e) formulation of a theory for continued study, and (f) the enunciation of a law after substantial trial and discussion. With these steps in mind the present status of our work with engineering laminates presents a curious and extremely interesting conglomerate of the first three steps in this approach."

In order to give an appreciation of engineering laminates the Lecturer channeled his discussion on the following topics: "certain aspects of the theory involved in the structure of the atom and the bonds which exist; a consideration of crystallography as it applies to crystal structures, the lattice and the energies involved with their relation to this problem; and a rather simple study of the elusive subject of adhesives and their relation to surface energy and molecular forces. These form a necessary base for any discussion of engineering laminates as exemplified by the sandwich types of materials which we presently are using commercially. Much of this fundamental theory applies equally to many of our other engineering materials."

He devoted a portion of the Lecture to the discussion of adhesion, pointing out that probably adhesion is primarily a chemical phenomenon, and that gripping quality of the surface contributes little to the actual adhesion. He surveyed some of the relations which exist when metals, rubbers, wood, and glass are bonded in laminates, and showed some of the examples of the use of laminates indicating that their future was very bright. He noted a number of the difficulties encountered in making tests of laminates. He noted that the field of peel and cleavage evaluation offers a challenge to our ablest minds and that the creep or plastic flow studies will undoubtedly involve the obtaining of stress-strain data.

He concluded, "I thus come to the end of our simple journey over the road of pure and applied research. I hope you have found at least certain areas interesting and stimulating. My fondest hope, however, is that I may have proved that the Society should continue its search for the properties of materials by applied research and that there will be some who will explore the 'why' in areas of doubt. If our correlation of these efforts is extensive and if the search for 'whys' is vigorous, we will make progress with assurance.

" 'The development of modern science is secured not by the progress of any special branch of knowledge, but rather by the united efforts of various sciences and their mutual assistance in this striving forward.' (Sun Yat-Sen)"

Professor Voss' Lecture will be issued in the form of a special pub-

Showing one of the largest radio antennas ever built, fabricated from wood and expanded sheet aluminum. Professor Voss pointed out in his Marburg Lecture that the great advantage of the many different laminates is their susceptibility to forming and this coupled with the possibility of providing surfaces resistant to many types of exposure and use make them extremely valuable in prefabricated assemblies.

lication, including the large number of illustrations. The practice has been to publish the Lecture usually in the fall of the year and it is then also included in the current *Proceedings*.

Attendance

Total attendance at A.S.T.M. annual meetings is influenced by a number of factors: the hotel accommodations available, nature of the technical program, the various technical committees which may or may not meet, etc. Comparable registration figures for certain annual meetings are given in the following table. The 1937 and 1944 meetings were held in New York, the '40 meeting was in Atlantic City, the '43 meeting was in Pittsburgh and 1946 in Buffalo.

REGISTRATION ANNUAL MEETINGS

Year	Members	Committee Members	Visitors	Total
1937	960	186	377	1523
1940	912	256	273	1441
1943	757	323	372	1452
1944	1185	368	510	2063
1946	978	405	452	1835
1947	1071	469	246	1786

Reports on Ferrous Metals, Miscellaneous Subjects

The 18th Session of the Annual Meeting was devoted entirely to the presentation of reports, seven dealing specifically with the "A" (Ferrous Metal) Committees, and other reports covered Paints, Methods of Testing, Metallography, Radiographic Testing, etc.

The report of Committee A-1 on Steel, as usually is the case, contained quite a number of recommendations on Standards. This year seven new tentative specifications were offered and there were a number of last-minute changes approved, particularly affecting specifications for steel for boiler and pressure vessels. The new Tentative Minimum Requirements for the Deformation of Deformed Steel Bars for Concrete Reinforcement is somewhat of a departure from the usual type of specification developed in the Steel Committee. While this was approved as tentative, it cannot be invoked for a year at least (except by mutual agreement on the part of purchaser and producer) since the committee asked that the three product specifications covering billet, rail steel and axle steel bars be not formally revised but that a *tentative revision* be established which when adopted say in 1948 will permit a reference to the requirements on deformations. The tentative specification covering machine bolts and nuts and tap bolts for general use should meet a need for standardized requirements for these materials which find a myriad of uses.

Five tentative specifications and recommended practices developed through the work of Committee A-3 on Cast Iron and issued previously are to be referred to letter ballot for adoption as standard. These cover Automotive Gray Iron Castings, Thin-Sectioned Castings, Terms Relating to Cast Iron, Evaluating Microstructure of Graphite, and Torsion Tests.

The new Test for Permeability of Paramagnetic Materials developed initially in Committee B-4 and sponsored by Committee A-6 provides a relatively accurate and simple test to determine whether certain materials are sufficiently nonmagnetic for applications where these particular properties are desirable. The new A-6 Specifications for Flat Rolled Electrical Steel set up general requirements to which the material should conform, but specific limits are to be covered by individual specifications which would be referred to in the purchase order. A suggested example is given as part of the general specification.

The report from Committee A-5 on Corrosion of Iron and Steel was featured by extensive data (not preprinted) resulting from the testing and inspection of wire or steel wire and its products, these country-wide tests having been underway for a number of years. Intensive and at times spirited discussion of specifications for long terne iron or steel sheets resulted in agreement on requirements. In the specification, classifications are given differentiating the types of material as follows:

Long Terne Sheet.—Iron or steel sheet coated with a lead-tin alloy known as terne metal or terne alloy. Dimensions are limited only by mill equipment.

Short Terne Plate.—The name given to black plate when it is coated with a lead-tin alloy known as terne metal or terne alloy.

Black Plate.—Black plate is iron or steel sheet produced in widths over 12 to 32 in., inclusive, and with thicknesses of No. 29 gage and lighter for tin or terne plating.

The specification points out also that terne alloy is defined as an alloy of lead and tin with no exact specified composition other than that a tin content of up to 25 per cent is permitted for ease of manufacture. A companion document was also approved covering Tests for Weight and Composition of Coating on Long Terne Sheets.

The Committee on Radiographic Testing held an interesting series of meetings and although there were no recommendations in the report other than that the Tentative Specification for Methods of Radiographic Testing of Metal Castings, E 15 – 39 T, be withdrawn, the report as usual was an informative, newsy account, of the committee's reactions to a number of problems in its field.

SUMMARY OF ACTIONS TAKEN AT ANNUAL MEETING AFFECTING STANDARDS AND TENTATIVES.

	Existing Tentatives Adopted as Standard	Standards in Which Revisions Will Be Adopted	New Tentatives	Proposed Revisions of Existing Standards Accepted as Tentatives	Existing Tentatives Revised	Standards and Tentatives Withdrawn	Present Total Standards Adopted	Present Total Tentatives
A. Ferrous Metals—Steel, Cast Iron, Wrought Iron, Alloys, etc.	13	28	17	4	12	5	157	62
B. Non-Ferrous Metals—Copper, Zinc, Lead Aluminum, Alloys, etc.	1	23	5	0	33	3	71	105
C. Cement, Lime, Gypsum, Concrete, and Clay Products	10	23	4	8	7	1	146	37
D. Paints, Petroleum Products, Paper, Textiles, Rubber, Soap, etc.	43	34	30	5	20	7	497	279
E. Miscellaneous Subjects, Testing, etc.	4	2	0	0	0	0	33	43
Total	71	110	56	17	72	16	904	526

This group, under the direction of Dr. H. H. Lester, Chairman, has just recently had approved by the Society a Tentative Industrial Radiographic Standard for Steel Castings, E 71 concerning the publication of which an announcement will be made shortly.

Dr. H. E. Seemann, Chairman of the Committee's Subgroup on Technical Research, submitted a helpful review of the year's literature, limited specifically to papers covering new information or developments in physical or photographic elements. This material will be published as part of the committee report.

Reports on Non-Ferrous Metals

Committee B-1 made minor changes in three standards and one tentative. The standards concerned were those for hard-drawn copper wire (B 1–40), medium-hard-drawn copper wire (B 2–40) and hard-drawn copper alloy wires (B 105–39). In each case there was a clarification of the tensile strength required in joints and in the method of measuring wire diameter.

Committee B-2 recommended the advancement to standard of the specification for Oxygen-Free Electrolytic Copper Wire Bars, Billets, and Cakes (B 170 – 44 T) without revision. During the year the committee had voted to release jurisdiction to the A.S.T.M.-A.W.S. Joint Committee on Filler Metal of the Specification for Brazing Solder (B 64 – 43) and the Specification for Silver Solder (B 73–29).

Presented along with the report of Committee B-2 was a paper by F. P. Huston of the International Nickel Co., "Hardness Chart for Nickel and High-Nickel Alloys," and the wealth of data included in this paper fills a long-felt need, and will be quite useful to members of Committee B-2 and others.

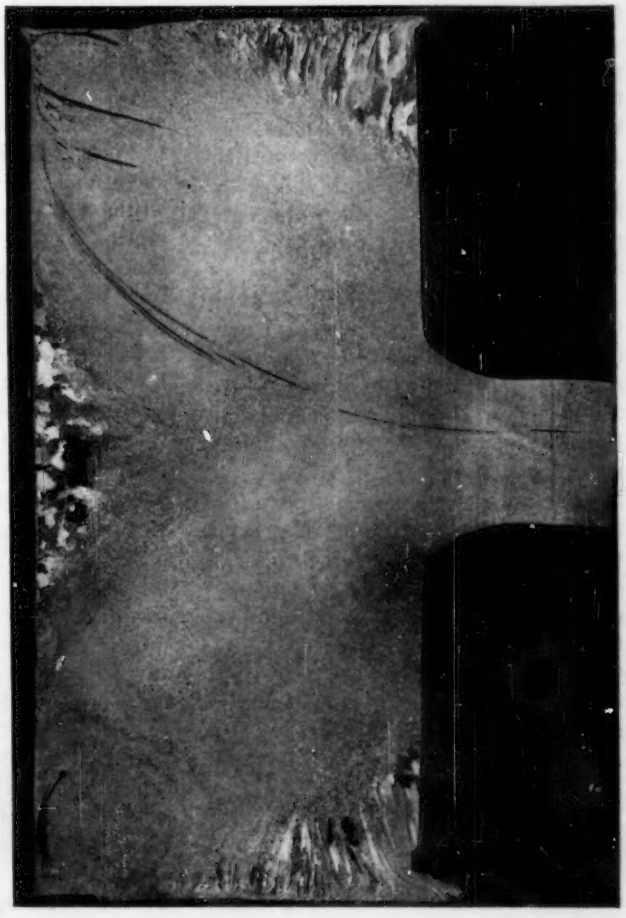
Committee B-4 presented to the Society two new proposed methods, one for measuring residual stress in metal-to-glass seals, and the other for testing fine round and flat wires for electronic devices, the latter being the consolidation and revision of Methods B 118 and B 156 which are accordingly being withdrawn. A full program of active work continues in this committee, particularly in the problem of evaluating the emissivity of cathode nickel.

Committee B-5 reported that nearly all of its specifications for wrought copper and copper alloy products had undergone revision. One new tentative was submitted to the Society along with revisions in 25 other tentatives and in 20 standards for immediate adoption. It was pointed out that the new method for tension testing of rod provided for the testing of full size specimens and also for testing various gage lengths not now covered in Method E-8. Specification B 151, covering copper-nickel-zinc alloy rod and bar, had been completely revised to eliminate requirements for wire now covered in B 206.

While the committee was recommending changes in nearly all of its wrought material specifications, it was noted that these fall into certain general categories. For example, in the various sheet and strip specifications, provisions have been added for material in plate sizes, and in these, as well as in the wire specifications, all reference to percentage reduction for various tempers and any mention of reduction in terms of B. & S. gage numbers had been deleted. In all the specifications, requirements for certain grades of raw materials had been deleted.

The main underlying idea of these recommended deletions both for raw material and for requirements for percentage reduction in drawing are based upon the feeling in the committee that a specification is not expected to provide a recipe for making material. A specification defines the properties desired in a finished product; and it usually provides methods for testing to ascertain if the material meets those requirements. Beyond that point, the committee feels it is superfluous to outline methods of manufacturing that product. This position is upheld by consumers who take the stand that such requirements cannot be checked in the finished product.

Committee B-6 recommended changes in Specifications for Magnesium-Base Alloy Die Castings (B 94 – 44 T) and for Copper-Base



"Partially Extruded Billet of Free Cutting Brass, Showing (1) Metal Flow, (2) Grain Refinement, (3) Origin of Extrusion Defect."

Honorable mention, semi-micro group, in the Fifth A.S.T.M. Photographic Exhibit, by Harold W. Hughson, Chase Brass & Copper Co.

(Brass) Alloy Die Castings (B 176 – 42 T). During the course of the year the special Research Committee which has been planning studies to determine the effect of die casting variables was constituted as a permanent Subcommittee IX on Die Casting Processes.

At the Annual Meeting, Committee B-7 submitted a new tentative Specification for Aluminum and Aluminum Alloy, Extruded Bars, Rods and Shapes, and recommended minor revisions in five, and the withdrawal of an additional tentative. An important paper on "The Determination of Elongation of Sand Cast Light Alloy Test Bars" by F. M. Howell of the Aluminum Company of America, which was presented at the February meeting of the committee, was appended to the committee report.

Appended to the report of Committee B-8, submitted at the Annual Meeting, were reports on the exploratory atmospheric exposure tests of copper-nickel-chromium deposits on high-carbon steel and reports on the condition of the electroplated lead coatings on steel after about two and a half years' exposure.

Committee B-9 submitted for approval a new tentative specification for Metal Powder Sintered Structural Parts, and reported that the glossary which now consists of 131 powder metallurgy terms will soon be submitted to the Society through the Administrative Committee on Standards.

At the conclusion of the session there was presented by the Advisory Committee on Corrosion the first report that it had ever submitted to the Society. The report outlined the history and present functions of the advisory committee, with particular reference to its responsibility for the acquisition and maintenance of test site facilities for atmospheric corrosion testing for all other committees of the Society. Appended to the report was a survey and history of A.S.T.M. corrosion testing from the beginning of the Society's activities in this field.

Reports on Cement, Concrete, Building Materials, Road and Paving Materials

The program of the Seventh Session of the Annual Meeting consisted of the presentation of the Sanford E. Thompson Award and committee reports covering cement, lime, refractories, concrete and concrete aggregates, mortars, glass, thermal insulating materials, natural building stones, road and paving materials, bituminous waterproofing and roofing materials, soils, fire tests, and methods of testing building constructions.

Committee C-1 on Cement presented recommendations covering revisions on three tentatives and three standards and in addition recommended the advancement to standard of one tentative. The most significant changes were the deletion of the $Al_2O_3 - Fe_2O_3$ ratio limits from the Standard Specification for Portland Cement (C 150) and from Type IIA in Tentative Specification for Air-Entraining Cement (C 175); increase in the air content limits for Types IA and IIA air-entraining portland cement (C 175); further changes as affecting the silicon dioxide, tricalcium silicate, and ferric oxide content of Type V portland cement (C 150) and granting permission to intergrind TDA with the clinker and slag in Tentative Specifications for Portland Blast-Furnace Slag Cement (C 205).

Recommendations presented by Committee C-7 on Lime consisted of the advancement to standard of existing tentative revisions covering methods of chemical analysis of limestone, quicklime and hydrated lime (C 25) and definitions of terms relating to lime now designated as C 51 – 44 T. Action has been taken by the committee for submission to letter ballot on an enlargement of the scope of the committee to include all forms of limestones used in the chemical process industries.

A new tentative specification for castable refractories for boiler furnaces and incinerators was presented for acceptance by Committee C-8 on Refractories, resulting from an investigation of the properties of 12 brands of widely used commercial castable refractories. This specification incorporates the use of A.S.T.M. standard test methods modified where necessary for use with castable refractories, and two classes for service — one at 2400 F. and one at 2700 F. Among a total of 26 recommendations presented, six represented tentative revisions of standards, seven for advancement of tentatives to standards, and 13 tentative revisions for adoption as standard. A revised edition of the widely used Manual of A.S.T.M. Standards on Refractories scheduled for publication this fall, provided impetus for the extensive list of recommendations.

Committee C-9 on Concrete and Concrete Aggregates completed a year of much activity both in the study of new standards and revision of the old. The committee presented for acceptance a new tentative method of testing concrete which embodies the latest development in this field—a method of test for fundamental transverse frequency of concrete specimens for computing modulus of elasticity (sonic method). A revision of the tentative method of making and curing concrete compression and flexure test specimens in the laboratory (C 192 T) now provides for the inclusion of machine mixing. A revision for immediate adoption in the standard method of test for abrasion of coarse aggregate by the Los Angeles machine (C 131) gives more definite reference to the sieves used while a tentative revision of the same method provides for testing larger sized aggregate than is now used. A number of changes in the standard specifications for ready-mixed concrete (C 94) influenced the committee to recommend reversion to tentative status. The most outstanding change is that which provides for transportation of ready-mixed concrete in nonagitating equipment.

It was announced that as of the present date, the new organization structure of the committee was in effect, which consists of three groups of subcommittees, namely, administrative, research, and specifications and test methods.

Committee C-12 on Mortars for Unit Masonry reported progress on the formulation of test methods covering the workability and on the determination of efflorescing tendencies of mortars.

The most significant progress reported by Committee C-14 on Glass

(*Please turn to page 12*)

NEW OFFICERS

The recent election of officers, as announced at the Annual Meeting by the tellers, resulted in the unanimous election of T. A. Boyd, as President (1947–1948), J. G. Morrow, as Vice-President (1947–1949), and the following as Directors (1947–1950): T. S. Fuller, Everett G. Ham, J. J. Laudig, H. L. Maxwell, Louis J. Trostel. Also, the Board of Directors announced the appointment of Gerald C. MacDonald as a member of the Board, to fill the unexpired term of A. T. Chameroy, resigned. Biographical material on these eight men follows:

L. J. Trostel J. J. Laudig E. G. Ham

President

T. A. Boyd, the new President, is Head, Fuel Dept., Research Laboratory Div., General Motors Corp., Detroit 2, Mich. Mr. Boyd received his Bachelor of Chemical Engineering degree from Ohio State University in 1918 and the degree of Ch.E. was awarded in 1938. Beginning in 1918 he was Research Chemist, Dayton Metal Products Co., and when the Research Division of this organization became a part of the General Motors Corp. in 1920 forming the basis of its central research division, Mr. Boyd continued in this work. Since 1923 he has been head of the Fuel Department. Co-discoverer with Messrs. Kettering and Midgley, of the anti-knock effects of the liquid compounds of lead, his principal subject of research has been automobile and aircraft fuels, and how to use them in engines to best advantage. His researches have been concerned chiefly with the noisy and power-limiting bugbear of knock—what knock is, and how to reduce it or to eliminate it altogether as a barrier to improving the power and the efficiency of automotive engines. Out of these researches have come contributions of importance both to the automobile gasolines of the present and to the high-output aviation gasoline which proved to be of such paramount importance in World War II. A prolific writer, Mr. Boyd has been the author or co-author of over 50 technical papers and articles, numerous popular articles and he has written two books.

He has been a member of A.S.T.M. for many years, and from 1931 to 1946 was Chairman of Committee D-2 on Petroleum Products and Lubricants. He is still active in that committee work. Mr. Boyd serves on Committee E-1 on Methods of Testing and is also a member of the A.S.T.M. Detroit District Council.

His membership in technical and professional organizations includes the following: American Chemical Society, American Institute of Chemical Engineers, American Association for the Advancement of Science, Society of Automotive Engineers, American Petroleum Institute, Michigan Academy of Arts and Sciences, New York Academy of Sciences, and Engineering Society of Detroit (President, 1943–44). He is also a member of the Chemists Club (New York); the Torch Club of Detroit and the Detroit Boat Club.

Vice-President

J. G. Morrow, the new Vice-President, is Metallurgical Engineer, The Steel Company of Canada, Ltd., Hamilton, Ontario. Following his elementary school training in the public schools of Hamilton, Mr. Morrow attended the Collegiate Institute, specializing in Chemistry. His work with the Steel Company began in 1905 as Chemist; later he was Inspecting Engineer and has been Chief Metallurgist and Inspecting Engineer for many years. He has been affiliated with A.S.T.M. since 1911 and has been especially concerned with work of Committee A-1 on Steel and Committee E-4 on Metallography.

In Canada he has rendered notable service in the work of the Canadian Standards Association of which he has been Chairman for some time. During World War II he rendered technical advisory service to the Canadian Steel Controller and also served on Committees of the U. S. War Production Board. His other technical affiliations include: The Canadian Institute of Mining and Metallurgy, American Iron and Steel Institute, Society of Automotive Engineers, and The Wire Association.

G. C. MacDonald H. L. Maxwell T. S. Fuller

New Members of Board of Directors

Truman S. Fuller, Engineer in Charge of Works Laboratory, General Electric Co., Schenectady, N. Y., was born in Saratoga Springs, N. Y. He graduated from Syracuse University in 1911 with a degree of B.S. in Chemistry and entered the employ of the General Electric Co. as chemist at the Edison Lamp Works, Harrison, N. J., on July 1, 1911. Three months later he was transferred to the Research Laboratory as metallurgist at Schenectady. In 1938 he became Engineer of Materials, Works Laboratory; in 1943 he became Assistant Engineer of that division and on July 1, 1945, Mr. Fuller was appointed Engineer in Charge of the Works Laboratory.

Participating in A.S.T.M. work for many years, he is a former member of the Executive Committee (now Board of Directors) having served in 1939–1941. He has been an active member of a large number of A.S.T.M. technical committees in all fields of activity. Mr. Fuller is a long-time member of Committee B-3 on Corrosion of Non-Ferrous Metals and Alloys and served as chairman of this important committee from 1926 to 1940. During this period the committee inaugurated many very extensive corrosion tests. Other A.S.T.M. technical work in which he has been and is still active includes aluminum and magnesium alloys, steel, cast iron, corrosion of iron and steel, stainless alloys and radiographic testing. For many years he served on the Research Committee on Fatigue of Metals. A writer of many papers, particularly on metals and alloys, he also is active in the work of other technical organizations and holds membership in the following: American Society for Metals, American Institute of Mining and Metallurgical Engineers, the British Institute of Metals, and the British Iron and Steel Institute.

E. G. Ham, Technical Director, John A. Manning Paper Co., Inc., Troy, N. Y. graduated from the University of Maine in 1916 with a degree of B.S. in Chemical Engineering. He has devoted practically his entire life to the manufacture of paper and paper products. He has been affiliated with the Manning Paper Co. for many years, was Chief Chemist, and now directs the technical activities of that organization. Active in A.S.T.M. work for many years, he has served on Committee D-9 on Electrical Insulating Materials since 1927. He is on the Subcommittee on Insulating Papers and is chairman of the section on physical tests. A member of A.S.T.M. Committee D-6 on Paper and Paper Prod-

ucts since its organization in 1937, he serves on the Advisory Committee and participates in the work on paper testing methods.

Mr. Ham has been active in the work of the Technical Association for the Pulp and Paper Industry and serves on a number of its technical committees.

JAMES J. LAUDIG, Research Engineer, Delaware, Lackawanna and Western Railroad Co., Scranton, Pa., is a native of Pennsylvania. After his graduation from Technical High School in Scranton, he received his B.S. in Chemical Engineering in 1916 from the Carnegie Institute of Technology, and his Chemical Engineer degree in 1927. Following a short period of service as Metallurgical Chemist for the Delaware, Lackawanna, and Western Railroad he was Metallurgical Chemist in charge of the St. Louis Ordnance District in World War I. He returned to the D. L. & W. and was Assistant Chemist and Engineer of Tests until 1926, and has been Research Engineer since 1934. A member of A.S.T.M. since 1921, Mr. Laudig has rendered active service on several technical committees, particularly A-1 on Steel. He is also concerned with the work of Committee D-19 on Waters for Industrial Uses.

His other technical affiliations include: the American Railway Engineering Association, the American Welding Society, and Professional Engineers, State of Pennsylvania. With two sons, one formerly in the Navy now studying at Penn State, and another in the 27th Army Division in Japan, Mr. Laudig has been very active in the work of the Boy Scouts of America.

H. L. MAXWELL, Supervisor of General Consultants, Engineering Dept., E. I. du Pont de Nemours & Co., Wilmington, Del., following his graduation from Cornell College, Iowa, served in the U. S. Army 1917–1918. He later studied at Iowa State College where he received his Ph.D. in Chemical Engineering and Metallurgy in 1924. He was Instructor in Industrial Chemistry at Iowa State College for two years, and was Associate Professor of Chemical Engineering at Purdue University for the period 1926–1930. The next three years he was Metallurgist for the du Pont Company in the Ammonia Department, and from 1936 to 1947 he was in charge of Metallurgy in the Engineering Department at du Pont. An authority on many of the problems of metallurgy and related fields entering into the extensive use of chemical equipment, Dr. Maxwell has been active in A.S.T.M. Committee A-10 on Iron-Chromium Iron-Chromium-Nickel and Related Alloys. He also serves on a special committee on stainless tubing jointly sponsored by Committee A-10 and Committee A-1 on Steel.

Dr. Maxwell is a member of several technical and scientific societies and has been particularly active in the American Society for Metals. Other memberships include: American Chemical Society, American Institute of Chemical Engineers, American Institute of Mining and Metallurgical Engineers, British Iron and Steel Institute, Society for Experimental Stress Analysis, and the American Welding Society. During World War II he served on committees of the War Production Board and in 1945 spent some time in Europe on technical missions.

L. J. TROSTEL, Manager of Research and Testing Laboratories, General Refractories Co., Baltimore, Md., is a native of Ohio. He received his technical education at Ohio State University, which in 1918 gave him his degree of B.S. in Ch.E. and in 1936 his degree of Chemical Engineer. In 1937 he received his Ceramic Engineering degree. Following engineering positions with the U. S. Bureau of Mines and the U. S. Bureau of Chemistry he joined the staff of the General Refractories Co. in 1923 as Chief Chemist in the Research Department. A member of A.S.T.M. since 1925 he has been particularly active in the work of Committee C-8 on Refractories. He was Secretary of this group from 1926 to 1932 and has served as vice-chairman since 1940. He has served on many of the subcommittees of Committee C-8 and at present is chairman of the section on analytical tests and the editorial subcommittee. He is also active in the work of A.S.T.M. committees concerned with plasticity, consistency and related problems.

A past President of the American Ceramic Society, 1942–1943, Mr. Trostel is a former chairman of its Refractories Division. His other memberships include: Canadian Ceramic Society, American Refractories Institute, American Institute of Chemical Engineers, Institute of Ceramic Engineers, and American Chemical Society. He has served on the Joint Committee on Foundry Refractories.

GERALD C. MACDONALD, Manager Quality Control, Montgomery Ward, Chicago, Ill., was born in upper New York State and received his Chemical Engineering degree from the Polytechnic Institute of Brooklyn. After receiving his master's degree from Columbia University, he took additional courses in Industrial Engineering and Business Administration at Columbia. Mr. MacDonald was associated with R. H. Macy & Co. for three years as Assistant Manager in the Bureau of Standards Department, later he was Manager of the Montgomery Ward Bureau of Standards for 4½ years and has been in his present position for the last three years. His activities involve coordination and general direction of the Division of Laboratories, Division of Merchandise Inspection, Division of Factory Inspection, Division of Merchandise Service Auditing, and the New York Office Division. He has been intimately connected with many of the technical problems in the field of ultimate consumer goods and serves on the A.S.T.M. Administrative Committee on this subject. He participates in the work of several committees functioning in the American Standards Association. He is a member of the American Society for Quality Control, and is active in the work of the Mail Order Association of America. Mr. MacDonald was appointed by the Board of Directors to fill the unexpired term of A. T. Chameroy, the term expiring in June, 1949.

Annual Meeting

Notes on Report Sessions and Others

(*Continued from page 10*)

and Glass Products is toward the establishing of a test method on chemical durability of pharmaceutical containers. During the year the first edition of the special compilation of "A.S.T.M. Standards on Glass and Glass Products" was published. One recommendation was presented for the advancement to standard of the tentative definition of the term glass (C 162 T).

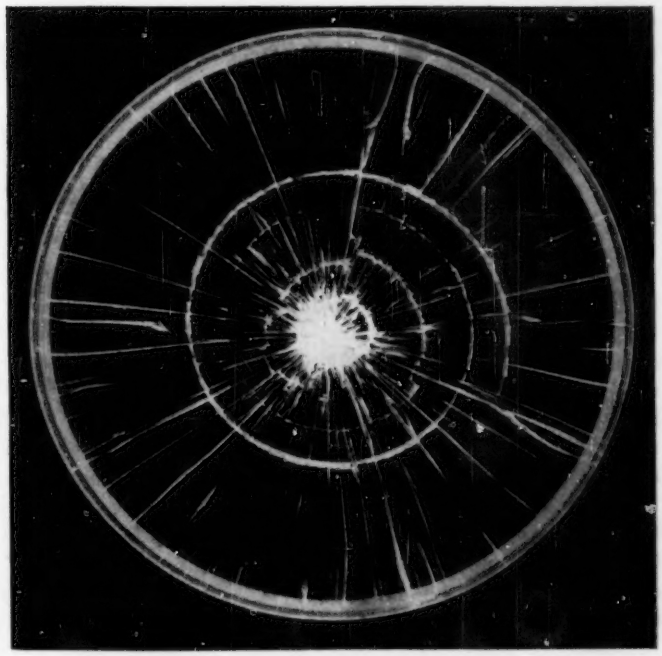
A new test method for water vapor permeability of sheet materials used in connection with thermal insulation was accepted as part of the report of Committee C-16 on Thermal Insulating Materials. Six additional definitions of terms relating to thermal insulating materials were accepted. Three tentative specifications covering mineral wool thermal insulating cement (C 195 T), expanded or exfoliated vermiculite thermal insulating cement (C 196 T), and diatomaceous silica thermal insulating cement (C 197 T) were revised to include a section on compositions.

Committee C-18 on Natural Building Stones presented for immediate adoption revisions of the standard method of test for absorption and apparent specific gravity of natural building stone (C 97) and the standard method of flexure testing of natural building stone (C 99).

Committee D-4 on Road and Paving Materials joined with Committee D-18 on Soils for Engineerng Purposes in presenting two new tentative test methods. These methods cover shear strength of flexible road surfaces, subgrades and fills by the Burggraf Shear Apparatus (as described in "Procedures for Testing Soils," September, 1944,) and a test method for soil-bituminous mixtures. The latter was originally prepared by a group representing producers of typical bituminous materials used for stabilization of hgihway soils, followed by extensive study and review on the part of the joint subcommittee. A tentative revision of the long-standing test method for penetration of bituminous materials (D 5) was submitted which involves modified or more specific requirements designed to improve the reproducibility and reliability of the method. An additional method for determination of

residue by evaporation as an alternate to the distillation method was submitted as a tentative revision of the Standard Methods of Testing Emulsified Asphalts (D 244). This is a joint recommendation of Committee D-4 and Committee D-8. Three tentative specifications were recommended for adoption as standard covering standard sizes of coarse aggregate (D 448), tar (D 490) and crushed stone, crushed slag and gravel for bituminous concrete bases and surface courses (D 692). Jointly with Committee D-18 the test method for cement content of soil-cement mixtures (D 805 T) was proposed for adoption as standard. Several proposed tentatives will be referred to the Administrative Committee on Standards as a result of committee action, two significant items cover specifications for asphalt cements and hot-mixed, hot-laid asphaltic concrete base and surface courses.

All tentatives and standards under the jurisdiction of Committee D-8 on Bituminous Waterproofing and Roofing Materials were reviewed. The tentative methods of sampling bituminous materials (D 140 T) will now include a section simplifying the scope of this method. Revisions were made in tentative methods of testing asphalt roll-roofing, cap sheets, and shingles (D 228 T) which will clarify the application of these methods and improve the accuracy. In order to eliminate asphalt which may slide excessively when applied to vertical surfaces in direct sunlight or exposed to temperatures above 125 F., a revision has been made in the tentative specifications for asphalt for damp-proofing and waterproofing (D 449 T). This change affects the minimum requirement for softening point and ductility for type C asphalt. Revisions for immediate adoption will affect the specifications for asphalt saturated roofing felt for use in waterproofing and in constructing built-up roofs (D 226), and coal-tar saturated roofing felt used for the same purpose (D 227). The revised specifications will now conform to the new standards which have been agreed upon by the roofing industries, the Division of Simplified Practices of the U. S. Department of Commerce and those which have been accepted by Underwriters' Laboratories and the Federal Specifications Board.



"Cornu Spiral. When laminated glass lens breaks like this, perfect harmonic vibration occurs, no glass leaves either surface."

Third prize-winning photograph, nonprofessional, black and white or monochrome prints, general section, in the Fifth A.S.T.M. Photographic Exhibit, by Edward W. Hettinger, Willson Products Co., Inc.

In addition to several recommendations on test methods representing considerable work on the part of the subcommittees, Committee D-18 on Soils for Engineering Purposes, put into effect a major reorganization based on the grouping of small subcommittees under three major heads —administrative, research, and standards. The committee sponsored two technical sessions at the Annual Meeting, one a Symposium on Load Testing and the other a group of papers of general interest in the field of soil mechanics. Along with the two new tentative methods recommended jointly with Committee D-4 — Testing Soil-Bituminous Mixtures and Test for Shear Strength of Flexible Road Surfaces, Subgrades and Fills — a third tentative was presented covering the field determination of density of soil in place.

The principal activity of Committee E-5 on Fire Tests of Materials and Construction pertaining to recommendations on standards consisted in further refinement of two test methods. The tentative revision of the comprehensive Standard Method of Fire Tests of Building Construction and Materials (E 119) accepted last year with minor revisions, has been recommended for adoption as part of the standard itself and the Tentative Method of Test for Combustible Properties of Wood by the Fire-Tube Test Method (E 69 T), with a minor revision, will be advanced to standard.

The first objective reached by the Committee E-6 on Methods of Testing Building Constructions since its organization less than two years ago was in the presentation and acceptance of Tentative Methods of Conducting Strength Tests of Panels for Building Constructions (E 72 T). This new tentative was accepted by the Administrative Committee on Standards in May of this year. The tentative describes in detail methods for determining the strength and behavior of building constructions under compressive, transverse, impact, concentrated, and racking loads. Other test methods on structural elements, large structural units and connections and assembled structures are in the process of formulation. The scope of the committee has been expanded to include the subjects of durability, insulation, sound transmission, and fire resistance, which generally will require close collaboration with other existing technical committees.

Reports of Committees on Miscellaneous Materials

The presentation of reports from a group of "D" committees represented the program of the Seventeenth Session. These reports cov-

ered materials of considerable range and included coal and coke, paper, shipping containers, rubber, soaps, textiles, adhesives, and water for industrial uses.

The Report of Committee D-19 on Water for Industrial Uses noted that the committee had sponsored the session of papers on water and was progressing in its preparation of an A.S.T.M. Manual on Industrial Waters. Four new tentatives were accepted — two covering test methods for the detection of iron bacteria in industrial waters and a method of reporting results of chemical analysis of water-formed deposits, and two covering recommended practices for application of X-ray diffraction methods to water-formed deposits, and for corrosion tests in industrial waters (NDHA Method). Methods for determining manganese (D 858 T) and silica (D 859 T) were revised in the interest of precision and further clarification. The standard method for determination of the hydroxide ion in industrial waters (D 514) was revised by immediate adoption deleting the reference to phosphate. The standard methods of sampling plant or confined waters for industrial uses (D 510) have been completely revised and will revert back to tentative status.

The standard method of sampling coal (D 21) which was originally adopted in 1916 was recommended for withdrawal by Committee D-5 on Coal and Coke. The development of new methods based upon statistical studies of sampling in relation to the ash content of the coal resulted in a new method which was adopted in 1946 (D 492).

Five new test methods were included in the report of Committee D-6 on Paper and Paper Products. Methods of testing the bleeding resistance of asphalted papers at elevated temperatures, the copper number of paper and paperboard, the blocking resistance of paper and paperboard, the determination of titanium dioxide in paper, and the crease retention of wrapping paper contribute valuable new aids in the field of testing paper and paper products. The committee has felt justified in recommending the advancement to standard of four tentative methods covering the adhesiveness of gummed tape (D 773), the absorption by bibulous papers of water and writing ink (D 824), the degree of wet curl of paper (D 826), and the edge tearing strength (D 827).

Excellent examples of simulated service tests are exemplified in the four tentative test methods referred to by Committee D-10 on Shipping Containers for advancement to standard. A drop test (D 775), compression test (D 642), incline impact test (D 880), and a test using a revolving hexagonal drum (D 782), comprise this group.

Committee D-11 on Rubber and Rubber-Like Materials presented three new tentative test methods. A method of test for contact and migration strain of organic finishes by vulcanized rubber give procedures for producing under standardized conditions strains caused by vulcanized rubber compounds on organic finishes. This method is of particular importance in the manufacture of refrigerators washing machines and light-colored automobiles. A procedure for determining the plasticity and recovery of uncompounded, compounded, or reclaim stocks of unvulcanized rubber and rubber-like materials employs the Williams' parallel plate plastometer which has been used for a number of years. The third tentative method covers a standard procedure for determining the viscosity of uncompounded, compounded, or reclaim stocks of unvulcanized rubber and rubber-like materials by means of the Mooney viscometer. Changes are effected in three existing tentatives, namely, the test method for compression set of vulcanized rubber (D 395 T) incorporating the use of plied specimens; the test method or indentation of rubber by means of the durometer (D 676 T), permitting the use of the Rex durometer or any other complying instrument of the maximum reading type; and the method of heat aging of vulcanized natural or synthetic rubber by the test tube method (D 865 T), consisting essentially of provision for entrance of additional air into the test tubes by convection currents through tubes inserted in the stoppers. A revision for immediate adoption in the standard methods of test for abrasion resistance of rubber compounds (D 394) deletes the use of the United States Rubber Co. abrader method. Extensive revisions in the standard method of test for adhesion of vulcanized rubber to metal (D 429), which include the addition of a stripping method, necessitated the reversion of this standard to tentative.

The streamlining of the structure of Committee D-12 on Soaps and Other Detergents has been effected by classifying its subcommittees into three groups according to function, namely, testing, specifications, and general. Among committee recommendations, two new specifications covering sodium bicarbonate and borax, respectively, were presented. In addition, a new method of immersion corrosion test of water-soluble aluminum cleaners was recommended.

Test methods on filament rayon yarns (D 258 T) have been extensively revised by Committee D-13 on Textile Materials, with lesser changes being made in the test methods for glass yarn (D 578 T), the latter consisting of more specific limitations on the average twist of the yarn. A tentative revision of the methods for testing felt (D 461) adds a new section referring to bursting strength.

It was announced that the scope of the ASA Sectional Committee L 14 on Textile Test Methods, for which the Society is one of the sponsors, has been enlarged to include all methods of testing textiles. The original scope was limited to test procedures dealing with color fastness of textile materials.

During the past year, Committee D-14 on Adhesives has had accepted by the Administrative Committee on Standards eight new tentatives. These consist of seven test methods on adhesives, covering the determination of tensile strength, peel or stripping strength, shear strength properties by compression loading, shear strength properties in plywood type construction by tension loading, resistance of adhesive bonds to chemical reagents, applied weight per unit area of dried adhesive solids and applied weight per unit area of liquid adhesives. The eighth tentative is a recommended practice for determining the effect of artificial and natural light on the permanence of adhesives.

Three Honorary Memberships Awarded

Messrs A. C. Fieldner, F. M. Farmer, H. S. Vassar Honored

THREE LONG-TIME members and former officers of the Society who have been very active in numerous phases of the Society's work in the field of standardization and research were awarded Honorary Memberships at the 1947 Annual Meeting at Atlantic City. These three men, Messrs. A. C. Fieldner, F. M. Farmer, and H. S. Vassar, have served A.S.T.M. in many outstanding ways and each is of widely recognized eminence in fields of work covered by the Society. Each of the three men has been an officer of technical committees, each is a former president of the Society, and it was most fitting that they should receive the highest honor which the Society can bestow.

The awards were made by President Carpenter at the Dinner on Wednesday, June 18, each of the men being presented by an A.S.T.M. past-president. John R. Townsend presented Mr. Farmer, P. H. Bates introduced Dr. A. C. Fieldner, and Dean Harvey gave the citation for Mr. Vassar. Each of the new Honorary Members responded appropriately expressing appreciation for the honor.

F. M. Farmer

H. S. Vassar

A. C. Fieldner

Arno C. Fieldner

Chief, Fuels and Explosive Service, U. S. Bureau of Mines, Washington, D. C., Dr. Fieldner was graduated in chemical engineering from Ohio State University in 1906, and after a short apprenticeship with the Denver Gas and Electric Co., entered the Government service as fuels chemist in the U. S. Geological Survey at Pittsburgh, Pa. In 1910, when this work was transferred to the newly created Bureau of Mines, he was placed in charge of the fuels chemical laboratory and later of the gas investigations laboratory also. During World War I he was in charge of the Gas Mask Section, Research Division of the Chemical Warfare Service, and was commissioned a Major. He developed the methods used for testing the efficiency of gas masks against various gases, and aided in perfecting gas masks for industrial use.

After the war, Dr. Fieldner returned to Pittsburgh as supervising chemist of the Pittsburgh Station and in 1921 was placed in charge of the Station. In 1925 he was appointed chief chemist of the Bureau of Mines, with headquarters at Pittsburgh, still retaining charge of the Station as superintendent. In 1927 he was placed in administrative charge of the Bureau's Experiment Stations Division, with headquarters in Washington, D. C. Subsequently he was chief of the Technologic Branch of the Bureau, and has for some time been in his present position.

Dr. Fieldner has been active in developing standard methods and apparatus for analyzing coal, has directed the Bureau of Mines' investigations on the ventilation of vehicular tunnels and has been the author or co-author of many scientific and technical papers. He designed the electric furnace now used as an A.S.T.M. standard for the determination of volatile matter in coal and developed the standard method for determining the fuzibility of coal ash.

A member of A.S.T.M. since 1914, he served the Society as a member of the Executive Committee, was Vice-President, and became President for the term 1936–1937. Possibly his outstanding technical committee affiliation is D-5 on Coal and Coke where he has served as Chairman from 1920 to the present time. He has had periods of service on Committee A-5 on Corrosion of Iron and Steel, Committee E-1 on Methods of Testing, and was the first chairman of Committee D-3 on Gaseous Fuels, on which he is currently serving.

Dr. Fieldner has been active in the work of the American Standards Association; was Chairman for a number of years of the Chemical Committee of the American Gas Association, and of the Gas and Fuel Division of the American Chemical Society.

A recognized world authority in his field, Dr. Fieldner has received numerous honors and recognitions, including in 1931 the Lamme Medal of Ohio State University, for meritorious accomplishment in engineering. The University of Alabama honored him with a Doctor of Science degree in 1936, and in 1946 he received the Percy Nichols Award jointly sponsored by the AIME Coal Division and the ASME Fuel Section. He was Melchett Lecturer and Medalist in 1942 before the British Fuel Institute. He is affiliated with a number of technical and scientific societies.

Hervey S. Vassar

Laboratory Engineer, Public Service Electric and Gas Co., Maplewood, N. J., Mr. Vassar received his education at Pratt Institute, Brooklyn, graduating in 1903 in Applied Electricity. Upon graduation, he became associated with the Public Service Electric and Gas Co., where he held various positions in engineering until 1911, and has been in his present position since 1911. He is in charge of all electrical, mechanical, and materials testing for his company.

He has been a member of the Society since 1915. He was a member of the Executive Committee from 1932 to 1934; served as Vice-President, 1934–1935, and President, 1935–1936. His 1936 Presidential Address was a most interesting and thought-provoking one entitled "The Testing of Non-Materials."

He has taken a very active part in various phases of A.S.T.M. work, chiefly involving materials pertaining to the electrical field. He has been particularly concerned with the work of Committees D-9 on Electrical Insulating Materials, and D-11 on Rubber and Rubber-like Materials. His service on Committee D-9 dates from 1918. He served as Secretary from 1922 to 1926, and was Chairman from 1926 to 1930. In Committee D-11, where his membership dates from 1917, he was for many years Chairman of Subcommittee IV on Protection of Persons from Electric Shock. He took an active part in the organization of the Sectional Committee on Electrical Insulating Materials sponsored by A.S.T.M. under A.S.A. procedure and is one of the representatives of the electric light and power group. He is also a member of Committee B-2 on Non-Ferrous Metals and Alloys.

He rendered notable service to the Society as a member and Chairman of the Administrative Committee on Standards in the period from 1939 to 1945. Certainly one of his outstanding services to the Society was as Chairman of the Special Study Committee which devoted much time and energy to a complete over-all study of A.S.T.M. activities. This group made a critical and objective review of the Society's work, and as a result of its examination and appraisal of Society operations a number of significant improve-

ments and changes in the Society's setup were effectuated.

In addition to A.S.T.M., Mr. Vassar is a member of several other organizations including the American Association for the Advancement of Science, American Institute of Electrical Engineers, and The American Society of Mechanical Engineers.

F. Malcolm Farmer

Vice-President and Consulting Engineer, Electrical Testing Laboratories, Inc., New York City, Mr. Farmer was born in Ilion, N. Y., where he received his early education, and later was graduated from Cornell University in 1899 with the Degree of Mechanical Engineer. Following graduation he was a student engineer at the General Electric Co. for about a year and a half; later, Inspector at the Navy Department, Brooklyn Navy Yard; and in 1903 he became affiliated with his present company. He was successively Technical Assistant, Engineer, Chief Engineer, and Vice-President.

His work has involved a variety of activities, but particularly those covering electrical measurements, electrical insulating materials, and high-voltage cables.

Mr. Farmer became affiliated with the Society in 1909 as a representative of his company and he has been a personal member since 1921. A member of the A.S.T.M. Executive Committee in 1921, he became Vice-President, and was President of the Society in 1924–1925. He was a member for many years of Committees D-9 on Electrical Insulating Materials, and D-11 on Rubber and Rubber-like Materials. He was Chairman of the former committee from 1922 to 1925, and an officer and member of several of its subcommittees. He was Chairman of Committee D-11 from 1921 through 1926. He served on other technical groups in A.S.T.M. and, was a member of the Committee on Papers and Publications from 1923 to 1928.

Mr. Farmer has rendered notable service to the Society through his representation of A.S.T.M. on other organizations, particularly the American Standards Association. He has served as the A.S.T.M. representative on the ASA Standards Council for many years and is a Past-Chairman of that group, also on the Electrical Standards Committee and on the U. S. National Committee of the International Electro-Technical Commission. He also served the Society on the American Bureau of Welding and in other capacities. He was a former chairman of the New York District Committee.

Mr. Farmer is a Past-President of the American Institute of Electrical Engineers and of the American Welding Society. He has given outstanding service to the engineering profession in other ways, including service on the Engineering Foundation, of which he is Past-Chairman. His other society affiliations include the American Society of Mechanical Engineers, the British Institute of Electrical Engineers, and the American Association for the Advancement of Science. During World War II Mr. Farmer rendered notable service to the war effort through his work with the New York Ordnance District where he was consultant on inspection methods.

WILLIAM LERCH—THOMPSON AWARD WINNER

A graduate of Beloit College, with an M.S. degree in Chemistry from the University of Wisconsin, Mr. Lerch has been with the Research Staff of the Portland Cement Association since 1923. For a number of years he was at the P.C.A. Fellowship, National Bureau of Standards in Washington, and since 1940 he has been in Chicago. He was appointed to his present position, Manager of the Department of Applied Research, January 1, 1947. He has written a number of papers and holds membership in various technical societies.

FRANK B. QUINLAN—TEMPLIN AWARD WINNER

A native of New York City, Mr. Quinlan entered the employ of the General Electric Co. in the Research Laboratory in 1929 as Laboratory Assistant. In October, 1944, his activities were transferred from the Research Laboratory to the Works Laboratory where he has been actively engaged in the testing of materials and concerned with research and testing problems in this field.

Reprint on Graphitization Discussion

FIVE interesting technical papers presented at a session of the A.S.M.E. annual meeting in December, 1946, have been printed as a 54-page booklet and while the supply received at A.S.T.M. Headquarters lasts, members can obtain a copy on request. This material is published by The American Society of Mechanical Engineers and constitutes a contribution by the Joint A.S.T.M.-A.S.M.E. Research Committee on Effect of Temperature on the Properties of Metals. The papers given are as follows:

Studies on Susceptibility of Casting Steels to Graphitization *by J. J. Kanter and E. A. Sticha*

Report on Graphitization Studies on High-Temperature Welded Piping of the Philadelphia Electric Company *by E. L. Hopping and A. E. White*

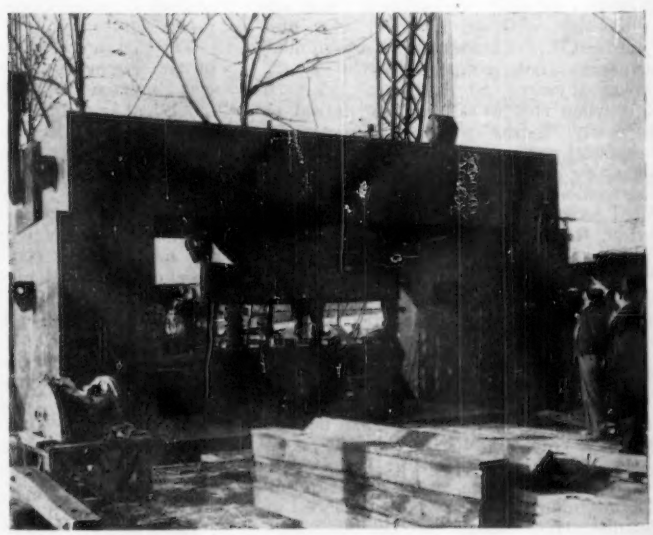
Graphitization Studies of Materials for High-Temperature Service *by W. G. Conant and W. A. Reich*

Continuation of Joint E.E.I.-A.E.I.C. Investigation on Graphitization of Piping *by S. L. Hoyt and A. M. Hall*

Influence of Postweld Heat-Treatment *by I. A. Rohrig and Arthur McCutchan*

Use of A.S.T.M Standards

IN CONNECTION with the testing of some of the material which went into the magnet for the super cyclotron illustrated here, certain A.S.T.M. tests were used, including those for determining the magnetic properties of iron and steel. The photograph shows the assembly of eight solid steel forgings, from Carnegie-Illinois Steel Corp., weighing an average of 150 tons each, to form the second largest magnet of a super cyclotron in the U. S., which is capable of producing particles of more than 200,000,000 electron volts. This was assembled at the University of Rochester in connection with the radiation program of the U. S. Navy. Note sizes of individuals watching the assemblage, as compared with the equipment.



List with Serial Designations of New and Revised Tentatives

THE SOCIETY accepted at the Annual Meeting 56 new tentatives and revisions in 72 former tentative specifications and methods of test. Of the revised tentative specifications and methods, 11 have been extensively revised and the titles of these are given below (marked with an asterisk) with the list of those issued by the Society for the first time. Standing committees responsible for the various items are indicated in italics.

Steel

(Committee A-1)

Specifications:

*Nickel-Steel Plates for Boilers and Other Pressure Vessels (A 203 – 47 T).

High Tensile Strength Carbon-Manganese-Silicon Steel Plates for Boilers and Other Pressure Vessels (A 299 – 47 T).

Steel Plates for Pressure Vessels for Service at Low Temperatures (A 300 – 47 T).

Chromium-Molybdenum Steel Plates for Boilers and Other Pressure Vessels (A 301 – 47 T).

Manganese-Molybdenum Steel Plates for Boilers and Other Pressure Vessels (A 302 – 47 T).

Hot-Rolled Strip of Structural Quality (A 303 – 47 T).

Alloy-Steel Rounds Suitable for Oil Quenching to End-Quench Hardenability Requirements (A 304 – 47 T).

Minimum Requirements for the Deformations of Deformed Steel Bars for Concrete Reinforcement (A 305 – 47 T).

Medium Carbon Bars to Mechanical Property Requirements (A 306 – 47 T).

Steel Machine Bolts and Nuts and Tap Bolts (A 307 – 47 T).

Corrosion of Iron and Steel; Magnetic Properties

(Committees A-5 and A-6)

Specifications:

Long Terne Iron or Steel Sheets (A 308 – 47 T).

Flat-Rolled Electrical Steel (A 310 – 47 T).

Method:

Test for Weight and Composition of Coating on Long Terne Sheets by the Triple Spot Test (A 309 – 47 T).

Test for Permeability of Paramagnetic Materials (A 311 - 47 T).

Iron-Chromium-Nickel and Related Alloys

(Committee A-10)

Specifications:

Seamless and Welded Austenitic Steel Pipe for High Temperature and General Corrosion Service (A 312 – 47 T).

Chromium-Nickel Corrosion Resisting Spring Wire (A 313 – 47 T).

Corrosion Resisting Billets and Bars for Reforging (A 314 – 47 T)

Non-Ferrous Metals and Alloys

(Committees B-4, B-5, B-7, and B-9, respectively)

Methods:

Measuring Residual Stress in Cylindrical Metal-to-Glass Seals (B 218 – 47 T).

Testing Fine Round and Flat Wire for Electronic Devices (B 219 – 47 T).

Tension Testing of Copper and Copper-Alloy Rods, Bars, and Shapes (B 220 – 47 T).

Specifications:

*Copper-Nickel-Zinc Alloy Rod, Bar, and Wire (B 151 – 47 T).

*Aluminum Sheet and Plate for Use in Pressure Vessels (B 178 – 47 T).

Aluminum and Aluminum-Alloy Extruded Bars, Rods, and Shapes (B 221 – 47 T).

Metal Powder Sintered Structural Parts (B 222 – 47 T).

Refractories; Concrete and Concrete Aggregates; Thermal Insulating Materials

(Committees C-8, C-9, and C-16, respectively)

Specifications:

Castable Refractories for Boiler Furnaces and Incinerators (C 213 – 47 T).

*Ready-Mixed Concrete (C 94 – 47 T).

Method:

Test for Fundamental Transverse Frequency of Concrete Specimens for Computing Modulus of Elasticity (Sonic Method) (C 215 – 47 T).

Test for Water Vapor Permeability of Sheet Materials Used in Connection with Thermal Insulation (C 214 – 47 T).

Definitions:

*Terms Relating to Thermal Insulating Materials (C 168 – 47 T).

Pigments and Paint Materials

(Committee D-1)

Specifications:

Mercuric Oxide for Use in Anti-Fouling Paints (D 911 – 47 T).

Dry Cuprous Oxide for Use in Anti-Fouling Paints (D 912 – 47 T).

Methods:

* Chemical Analysis of Dry Cuprous Oxide and Copper Pigments (D 283 – 47 T).

*Analysis of Diatomaceous Silica Pigment (D 719 – 47 T).

* Producing Films of Uniform Thickness of Paint, Varnish, Lacquer, and Related Products on Test Panels (D 823 – 47 T).

Evaluating Degree of Resistance of Traffic Paint to Chipping (D 913 – 47 T).

Testing Ethylcellulose (D 914 – 47 T).

Road and Paving Materials; Soils

(Committees D-4 and D-18)

Methods:

*Test for Penetration of Bituminous Materials (D 5 – 47 T).

Testing Soil-Bituminous Mixtures (D 915 – 47 T).

Test for Shear Strength of Flexible Road Surfaces, Subgrades and Fills by the Burggraf Shear Apparatus (D 916 – 47 T).

Paper and Paper Products; Wood

(Committees D-6 and D-7)

Methods:

*Testing Small Clear Specimens of Timber (D 143 – 47 T).

Test for Bleeding Resistance of Asphalted Papers at Elevated Temperature (D 917 – 47 T).

Test for Blocking Resistance of Paper and Paperboard (D 918 – 47 T).

Test for Copper Number of Paper and Paperboard (D 919–47 T).

Test for Crease Retention of Wrapping Paper (D 920 – 47 T).

Determining Titanium Dioxide in Paper (D 921 – 47 T).

Electrical Insulating Materials

(Committee D-9)

Specifications:

Nonrigid Polyvinyl Tubing (D 922 – 47 T).

Methods:

Sampling Electrical Insulating Oils (D 923 – 47 T).

Test for Power Factor and Dielectric Constant of Electrical Insulating Oil of Petroleum Origin (D 924 – 47 T).

Rubber Products

(Committee D-11)

Methods:

*Test for Indentation of Rubber by Means of the Durometer (D 676 – 47 T).

Test for Contact and Migration Stain of Vulcanized Rubber in Contact with Organic Finishes (D 925 – 47 T).

Test for Plasticity and Recovery of Rubber and Rubber-Like Materials by the Parallel Plate Plastometer (D 926 – 47 T).

Test for Viscosity of Rubber and Rubber-Like Materials by the Shearing Disk Viscometer (D 927 – 47 T).

Soaps; Industrial Aromatic Hydrocarbons

(Committees D-12 and D-16)

Specifications:

Sodium Bicarbonate (D 928 – 47 T).

Borax (D 929 – 47 T).

Methods:

Total Immersion Corrosion Test of Water-Soluble Aluminum Cleaners (D 930 – 47 T).

Test for Thiophene in Benzene (D 931 – 47 T).

Water for Industrial Uses

(Committee D-19)

Methods:

*Sampling Plant or Confined Waters for Industrial Uses (D 510 – 47 T).

Detection of Iron Bacteria in Industrial Waters (D 932 – 47 T).

Reporting Results of Chemical Analysis of Water-Formed Deposits (D 933 – 47 T).

Recommended Practices:

Application of X-Ray Diffraction Methods to Water-Formed Deposits (D 934 – 47 T).

Corrosion Test in Industrial Waters (NDHA Method) (D 935 – 47 T).

Publication Schedule for 1947—1948

Includes Supplements to Book of Standards, Special Compilations, Five-Year Index to Reports and Papers, Special Publications

With the appearance of the complete Book of Standards coupled with the unusually large 1946 *Proceedings*, all falling in a year of unprecedented congestion in all printing establishments, we now find ourselves faced not only with a large number of 1947 publication commitments but also with the problem of still publishing a number of items that were to be completed last year. These include such publications as the five-year Index to Reports and Technical Papers, the Symposium on Effect of Low Temperature on Materials, the Symposium on Spectroscopic Light Sources, and several compilations of standards. However, in all fairness to our printer it is desirable to state that in connection with the two Symposiums the burden did not lie entirely in the laps of printers but partly on the shoulders of some authors who found themselves in a postwar dilemma which prevented the completion of their manuscripts.

The regular 1947 publications, including in addition to *Proceedings* and Supplements to Book of Standards, the compilations of standards and the several special symposiums, aggregate some 10,000 pages.

Regular Publications

1947 Supplement to Book of Standards

The plan of issuing the Book of Standards triennially marks 1947 and 1948 as Supplements years. The 1947 Supplements to the 1946 Book of Standards will be issued in five parts in heavy paper covers. They will include all new and revised standards and tentatives adopted or accepted at the 50th Annual Meeting or by the Administrative Committee on Standards, and will aggregate some 1200 to 1500 pages.

1947 Proceedings

Again it is expected that the *Proceedings* will be a good size. With the practice of including certain papers published in the ASTM Bulletin as well as those papers offered for *Proceedings* publication and presented at the 1947 Annual Meeting, the estimated size of the 1947 *Proceedings* is about 1300 pages. The papers presented at the Annual Meeting as a part of the special symposiums will appear in the symposium publications.

1947 Index to A.S.T.M. Standards

With the continually increasing number of standards and tentatives, the value of the combined index of standards and tentatives grows. This is particularly significant in Supplements years in view of the increased number of standards books. Publication of this 1947 edition is scheduled for February, 1948, and should comprise about 250 pages.

1947 Year Book

The Year Book, containing a list of the complete membership and official company-member representatives (name, title, address, company, etc.) arranged alphabetically and also geographically and personnel of all A.S.T.M. committees, is furnished to members on request. The 1947 Book should aggregate 550 pages and is scheduled for distribution about November 1.

Five-Year Index to Committee Reports and Technical Papers

As mentioned above, the Index to Committee Reports and Technical Papers covering the years 1941-1945 was originally scheduled for publication last year, but due to the printer's commitments had to be held over for publication this year. The index covers all reports and papers published by the Society in the *Proceedings*, ASTM Bulletin, and all special publications. It is expected that the index will comprise 200 pages. It is hoped that we can have the index available for distribution early in 1948.

Special Compilations of Standards

The tabulation given below of special compilations of standards, several of which include supplementary material relating to the fields covered, should be viewed as an approximate schedule. There are so many factors affecting these books that it is not possible to give any accurate estimate of size or the date that they may become available. The size is affected by committee recommendations which may be coming through the Standards Committee and the date of issue is governed somewhat by editorial considerations, but to a great extent by the tremendous load our printers are carrying.

Special Technical Publications, Symposiums, etc.

Symposium on Paint and Paint Materials:

This Symposium comprises the

List of Pending Publications
(Discussed in Detail in Accompanying Article)

Regular Publications
1947 Supplement to Book of Standards
1947 Proceedings
1947 Index to A.S.T.M. Standards
1947 Year Book

Special Compilations
Pipe and Piping Materials
Copper and Copper Alloys, Cast and Wrought
Refractories
Paint, Varnish, Lacquer, and Related Products
Petroleum Products and Lubricants
Knock Test Manual

Adhesives
Coal and Coke
Electrical Insulating Materials
Rubber and Rubber-Like Materials
Soaps and Other Detergents
Textile Materials
Plastics

Technical Publications and Papers
Selected A.S.T.M. Standards for Students in Engineering
Tables of Chemical Composition and Properties of Heat Resistant Iron and Nickel Alloys
1947 Marburg Lecture
Manual on Fatigue Testing
Radiographic Standards for Steel Castings

Symposiums[1]
pH Measurement
Paint and Paint Materials
Rubber Testing
Synthetic Lubricants
Load Tests of Bearing Capacity of Soils
Measurement of Entrained Air in Concrete
Effect of Low Temperature on Materials
Plastics
Spectroscopic Light Sources

[1] Some of these items will appear in the 1947 *Proceedings*.

Committee Sponsoring	Title	Approximate Number of Pages	Approximate Publication Date
A-1	Pipe and Piping Materials	320	Nov.-Dec.
B-5	Copper and Copper Alloys, Cast and Wrought	478	Sept.-Oct.
C-8	Refractories	250	Oct.-Nov.
D-1	Paint, Vanish, Lacquer, and Related Products	580	Dec.-Jan.
D-2	Petroleum Products and Lubricants	740	Sept.-Oct.
D-2	Knock Test Manual	400-500	Oct.-Nov.
D-5	Coal and Coke	120	Aug-Sept.
D-9	Electrical Insulating Materials	610	Oct.-Nov.
D-11	Rubber and Rubber-Like Materials	580	Oct.-Nov.
D-12	Soaps and Other Detergents	220	Dec.-Jan.
D-13	Textile Materials	536	Oct.-Nov.
D-14	Adhesives	52	Aug-Sept.
D-20	Plastics	600	Nov.-Dec.

eleven papers presented at the morning and afternoon sessions of the Spring Meeting on February 25, 1947. The papers together with discussion will be published as a separate volume comprising approximately 150 pages and should be available for distribution in the fall.

1947 Annual Meeting Symposiums

Four of the Symposiums that featured the 1947 Annual Meeting will be published separately with discussion, although some of them may be included in the 1947 *Proceedings* as well. The symposiums in question are listed below.

Symposium on Rubber Testing.—Eight technical papers; estimated size, 120 pages.

Symposium on Synthetic Lubricants.—Three technical papers; estimated size, 64 pages.

Symposium on Load Tests of Bearing Capacity of Soils.—Six technical papers; estimated size, 100 pages.

Symposium on Measurement of Entrained Air in Concrete.—Eight technical papers; estimated size, 120 pages.

Special Publications

Symposium on Effect of Low Temperature on Materials:

This Symposium, to aggregate some 100 pages, comprises the five technical papers and the discussion presented at the meeting sponsored by the Philadelphia District Committee on Tuesday, March 19, 1946, in Philadelphia. As mentioned above, this is one of the Symposiums that was not available for publication last year. All but one of the manuscripts are now in our hands and it is hoped that this Symposium can be made available for distribution late in the fall.

Tables of Chemical Composition and Properties of Cast Heat-Resistant Iron and Nickel Alloys:

These tables of chemical composition and properties supplement those published by the Society in 1942 for wrought alloys. The new tables should aggregate approximately 40 pages and should be available for distribution in the late fall.

Manual on Fatigue Testing:

A Manual on Fatigue Testing is being prepared by Committee E-9 on Fatigue in view of the considerable divergence that now exists with regard to nomenclature, specimen design, methods of finishing specimens, methods of plotting data and interpretation of data. It is generally agreed that an authoritative manual will constitute a useful service on the part of the Society. This manual is being prepared in eight sections by authorities in the field and should aggregate some 150 pages. It is hoped that we can have the new manual available for distribution early in 1948.

1947 Marburg Lecture:

A very interesting Marburg Lecture was presented at the 1947 Annual Meeting by Prof. Walter C. Voss, Massachusetts Institute of Technology, on "Engineering Laminates." Professor Voss covered very completely a subject that is of such great interest in the postwar construction field involving houses, boats, airplanes, etc. Prior to its appearance in the 1947 *Proceedings*, the Lecture will be available in reprint form around the middle of November.

A.S.T.M. Radiographic Standards for Steel Castings:

During the war the Bureau of Ships, Navy Department, developed Radiographic Standards for Steel Castings. No comparable radiographic standards are generally available to commercial producers and users today. The successful experience of the steel casting industry with the Navy standards has led to widespread demand, that A.S.T.M. make available similar standards for commercial use. The

standards as sponsored by our Committee E-7 on Radiography will comprise 31 X-ray and 31 gamma-ray standard negatives for use in comparison with radiographic negatives on steel castings. These standards are being made available in loose-leaf binders to provide for substitution of new standards or insertion of additional standards. Standards are arranged in two books, one for X-ray and the other for gamma-ray. These should be available for distribution in the late summer.

Symposium on Spectroscopic Light Sources:

This is a symposium presented at the 1946 Annual Meeting which we were unable to have published last year. It is estimated that it will aggregate about 120 pages. As in the case above, one manuscript is still incomplete but we expect to have it in our hands shortly and we are planning to make the complete symposium available this fall.

Symposium on pH Measurement:

This Symposium was also presented at the 1946 Annual Meeting but suffered the same fate as the two symposiums listed above, that is, finding itself "squeezed" out due to the congested condition existing at our printers. The Symposium comprises seven papers and should aggregate about 100 pages. The papers are now in type and in the process of being prepared for printing and should be available for distribution in August.

Symposium on Plastics:

At a meeting of Committee D-20 on Plastics held in Cincinnati in March a Symposium on Plastics was held sponsored by that Committee. It is planned to publish the nine papers and discussion presented at this meeting as a special publication. The manuscripts are now being assembled, and the book, estimated to aggregate 120 pages, should be available in December.

Selected A.S.T.M. Standards for Students in Engineering:

The compilation of standards assembled for engineering students has met with ever-increasing demand each year in the various colleges and universities throughout the country. The 1947 edition aggregates 284 pages. This publication is now available for distribution.

Reprints of Existing Publications

In addition to the above special publications, the Society has on its program the replenishing of stock with revisions wherever necessary, of such publications as the Manual on Presentation of Data, Viscosity Conversion Tables, and the Viscosity Temperature Charts.

1947 Preprints

A THIRD mailing of preprints is now being prepared for distribution in August. These preprints will be mailed to all who have requested them on the preprint request blanks. This third installment will include the following:

Reports:

Board of Directors.
A-2 on Wrought Iron, Preprint No. 2.
D-18 on Soils for Engineering Purposes, Preprint No. 77.
E-1 on Methods of Testing, Preprint No. 81.

Papers:

McAdam, Geil and Jenkins, "Influence of Plastic Extension and Compression on the Fracture Stress of Metals," Preprint No. 30.
C. A. Menzel, "Procedure for Determining the Air Content of Fresh Concrete by the Rolling and Pressure Methods," Preprint No. 51.
Swanberg and Thomas, "The Measurement of Air Entrained in Concrete," Preprint No. 53.
G. M. Hain, "A Microworker for Lubricating Greases," Preprint No. 99.
L. A. Palmer, "Field Loading Tests for the Evaluation of the Wheel Load Capacities of Airport Pavements," Preprint No. 109.
J. F. Sebald, "An Evaluation of Test Methods for the Determination of Dissolved Oxygen in Deaerated Boiler Feed Water," Preprint No. 118.

This third mailing of preprints, together with the first two mailings, complete the distribution of preprints for 1947. In addition to these papers, the papers by W. P. Roop on "Transitional Evaluations and Treatment of Experimental Data Subject to Very Wide Scatter" listed on the preprint blank as Preprint No. 23, Clarke and Adams on "Measurement of Metal Polish Performance," Preprint No. 37; Gus Kaufman on "Micro Penetration of Lubricating Grease," Preprint No. 100 and the paper by E. George Stern on "Influence of Nonhomogeneity of Wood on Its Strength Properties," Preprint No. 101 are included in this issue of the BULLETIN.

As mentioned in the publication schedule appearing in this BULLETIN, the Symposiums on Measurement of Entrained Air in Concrete, Synthetic Lubricants, Rubber, and Load Tests of Bearing Capacity of Soils are being prepared now for early distribution as separate booklets. This leaves several papers that will not be available until their appearance in the *Proceedings*. This is primarily due to the limitations on composition and printing time at our printers. However, in all cases it is planned to have sufficient proofs struck off for distribution to those who have requested them for discussion purposes.

Reprints of Standards — 8½ by 11 In.

THE SUGGESTION has been made that some of our members would prefer to see A.S.T.M. standards when published separately appear in 8½ by 11-in. size, which would be a convenient size for appending to contracts and for filing purposes in regular letter files. Frequently it is necessary to reprint A.S.T.M. standards when used as reference documents in connection with contracts whereas if they were available in this standard size they could be purchased directly from the Society. We should be interested to know how many of the members would wish to secure the standards in this form.

It is understood this applies only to the publication of the standards as separates and not to the publication of the standards in the Book of Standards which, of course, is the 6 by 9-in. size.

The Chemistry of Commercial Plastics

A Book Review Based on the Life of "Anna Flogistine"

THERE SEEM to be two schools of thought in writing book reviews. One holds that the reviewer should be an expert in the field covered; that is to say, if a modern best-selling novel is to be properly reviewed, the reviewer should be either an ex-brothel keeper or vice-president in charge of swill at the local pig farm. The opposing school contends that the man for whom the book was written is the best judge of the adequacy of its contents, as determined by the criterion of usefulness. The present reviewer strings along with Group 2 if only to justify the anomalous position of an engineer presuming to review a book on chemistry. Further argument is presented by the fact that the author, in a commendable effort to make the book useful, devotes thousands of words to engineering properties, fabrication, and other items of a nonchemical nature.

In any event, reducing a technical book to an appetizing tablet is always difficult because of the jumpy and dry nature of the contents. For example, hopping from the sexless amides to the murderless vinyls is no doubt frightfully educational but is not likely to stir one's emotions on a dreary rainy day—or for that matter on any day. On the other hand, consider the novel. The first few chapters describe the depressing child life of the heroine Anna Flogistine in her crude cabin in Kentucky. Anna's old man is allergic to work and spends all his time sittin' in the corner chawin terbaccer and spittin' the juice, so her mother has to take in washing sequently the little girl grinds her dreary way through childhood and adolescence surrounded by the endless cycle of awashin' and aspittin', awashin' and aspittin'. This part of the novel is obviously written for the tobacco road set.

Next we find Anna ensconced in a swanky apartment in Greenwich Village, surrounded by Micasso prints (whatever they are) and gentlemen friends of doubtful age and doubtfuler intentions. She has changed her name to Dawn Lighthead and her men friends, for reasons known only to novelists, invariably wear white silk scarfs. But the old cycle pattern soon establishes itself, and we find Anna's discouraging awashin' and aspittin' replaced by Dawn's equally tiresome amashin' and aflittin'. These chapters, of course, are written for the bobbysox and juke box trade.

Eventually virtue must triumph so we find Dawn, who has gone into an art museum to get out of the rain, meeting up with a boy from Kentucky who's heart is full of gold and whose prosperous hardware store back home is full of tin and paint, which don't glitter so much as his heart but are more negotiable. After a whirlwind courtship (which lies about midway between the zephyr, or take-your-time courtship, and the hurricane type) the lovers get married and return to their native state to live happily ever afterward. Our heroine is now known as Anna again, and spends a contented life preparing nourishing meals for her mate and listening to soap operas on the radio, in other words, acookin' and asittin'. These chapters are written especially for readers at the bubble gum level.

That brings us, by devious means to be sure, to Dr. Reginald L. Wakeman's book on the Chemistry of Commercial Plastics (Reinhold Publishing Corp. $10). Wakeman, eschewing all appeal to emotion, presents a carefully edited compendium of existing information on all the plastics of commerce, even including a few (Styramic, Cerex, etc.) which are among the deceased for reasons, which in at least one case, have little to do with the merits. His presentation of each plastic is a masterpiece of orderliness, taking the reader along a carefully planned path which brings one rather effortlessly to a working knowledge of History, Chemistry, Manufacture, Fabrication, Properties and Applications, closing the chapter with an adequate bibliography.

It is traditional that a reviewer must find a mistake, presumably to prove he's read the book, even if he has to scan each page with an electron microscope. This reporter had the very devil of a job finding serious errors, or even omission of a worth-while plastic. In fact the book is surprisingly up to date, accurate, and complete. There is enough chemistry to set the high-polymer tongues wagging, and enough engineering to keep the practical man informed, and, if he reads the book carefully, out of serious trouble. Wakeman would be the last to claim that a book, any book, could substitute for actual experience. But the next best thing is book larnin', and this volume supplies it.

The volume is dedicated "To my wife, Gabrielle, whose constant aid and encouragement have made this work possible." Since a chemist who is a Director of Research would hardly find it necessary to consult his spouse on strictly chemical matters, we may assume that Mrs. Wakeman contributed heavily to collating the enormous amount of technical information which has enhanced the readability and general usfulness of the book. Consequently, we include her in our awards: the badge of good authorship to Reginald, an orchid to Gabrielle.

ROBERT BURNS

Metals in Modern Society

DR. Cyril Stanley Smith, member of A.S.T.M., and Director of the Institute for the Study of Metals, Chicago, wrote an interesting short article published in *Mining and Metallurgy*, in which he stresses the necessity of fundamental research on metals and alloys. He concludes as follows:

"Summarizing then, metallurgy is still to be regarded as an art; a highly developed art, but nevertheless an art, in which skill and empirical knowledge outweigh scientific understanding. The field is ripe for great advances in the formulation of general principles, for a wealth of uncorrelated experimental material exists. As theoretical knowledge increases, it will lead application and not, as in the past, follow it. We can look forward to a period in which the nature, structure, and behavior of metals are so well understood that alloys can be designed with certainty for new applications with little development work. Simultaneously, possibilities are attractive for getting better service from present alloys as their nature and treatment are understood, and of stopping the wastage of our limited natural resources by proper utilization of alloying elements."

ASTM Bulletin

AUGUST 1947

NO. 147

NINETEEN-SIXTEEN RACE STREET
PHILADELPHIA 3, PENNA.

Technical Activities

CERTAIN articles in this BULLETIN indicate a continuing great volume of technical activity. In the article summarizing high points of the Annual Meeting there are references to numerous significant technical committee reports, and the list of new or extensively revised tentatives is ample proof of the continuing heavy output of standardized requirements for the quality and testing of many materials not heretofore covered in specifications.

But possibly of most significance in determining technical committee activities is the article entitled "Some Current Standardization Projects" beginning on page 31. This is recommended reading for all concerned with the large number of materials and subjects covered. Everyone who peruses this material will no doubt agree that the Society has currently a great many important standardization and research projects in process.

The solution to many of the problems being studied will, of course, be given through the new specifications and tests that will be forthcoming during the year, and the committee reports and other publications that result.

New Director

G. C. MACDONALD, Manager, Quality Control Group, Montgomery Ward and Co., Chicago, Ill., has been appointed a member of the Board of Directors to fill the unexpired term of A. T. Chameroy, who resigned in May. Mr. MacDonald's term will expire in June, 1949. Biographical information and photographs, of Mr. MacDonald and the newly elected officers, appear elsewhere in this BULLETIN.

Discussion of 1947 Annual Meeting Papers

EACH YEAR a very considerable portion of discussion of papers and reports that is included in our *Proceedings* reaches us in the form of *written* discussion submitted after the Annual Meeting. As usual, written discussion of reports and papers presented at the 1947 Annual Meeting in Atlantic City, N. J., will be received by the Committee on Papers and Publications until September 15. However, all who plan to submit discussion are urged to send it to Society Headquarters as far in advance of this date as possible to facilitate preparation of material for the *Proceedings*.

Facts

A Short Message from President Boyd

"IT'S funny how a fellow with facts can break up an argument." This is one of the sayings of that Hoosier philosopher, Abe Martin. It is because those who have worked in A.S.T.M. have substituted facts for argument that so many sound advances have been made by the Society. An important one of the reasons why the Society has been so highly successful, and why that success has continued through a period long enough for the Society to have held this summer its fiftieth annual meeting, lies in the emphasis which from the first has been placed upon research, or upon finding the facts needed before setting up standards. It should be said that there is here no intention of belittling debate at all, for it is recognized that much debate occurs in committee meetings and that such debates often bring out facts.

Most of the research which contributes to the advancement of A.S.T.M. projects has been done and will continue to be done in the laboratories of committee members. That is the proved method by which the work of such a cooperative society as ours is carried on for the most part. The total of such research has been very large indeed, but in the future it will need to be larger still.

There is at times some research needed in committee work which is best sponsored and financed by the Society itself. Research takes so many man hours, though, that it is a costly endeavor. It is so costly, in fact, as to have moved Sir J. J. Thompson to say once that the most important kind of balance for a research laboratory to have is a balance at the bank. But, as was said by Arthur W. Carpenter in his presidential address at the last annual meeting, the principal of the Society's research fund—its present balance at the bank—is quite small. So far that balance, which has been growing slowly for a long time, amounts only to above 45,000 dollars. That amount of principal corresponds to an income of but 100 dollars a month. Naturally no more than minor searches can be financed with such a small sum. And that is why, as has been said a number of times before, one of the important things to be done in the future is to provide the Society with more adequate funds for research.

T. G. Boyd

PRESIDENT

Numerous Actions on Standards and By-law Revisions Submitted to Members for Letter Vote

At the 1947 Annual Meeting in Atlantic City approval was given to submit to letter ballot of the Society proposals from the technical committees involving some 183 standards and tentatives. These proposals as listed on the letter ballot which will be mailed to the entire membership in August, fall into two categories, namely the adoption of tentative specifications and tests as formal standards, and the adoption of revisions in existing standards.

Also listed on the ballot with details given in the *Summary of Proceedings* that will accompany the ballot and other circular material are proposed revisions of the By-laws involving a change in the time of submitting recommendations for appointments on the Nominating Committee and changes in the annual dues structure. These amendments were also accepted at the Annual Meeting for submission to letter ballot of the entire Society.

The letter ballot on the proposed amendments and the actions on standards will be canvassed on October 15.

Standards:

In connection with the actions on standards it should be noted that only by letter ballot of the entire Society membership can changes be made in the formal standards. The action of an annual meeting session alone, or in the interval between annual meetings the Administrative Committee on Standards, can approve for publication as *tentative* proposed new standards, can approve *revisions in tentative standards* (which are incorporated immediately), or can take action to permit publication as *tentative* of *proposed revisions in standards.* Many such actions, of course, are taken at the Annual Meeting and throughout the year by the Administrative Committee on Standards.

A complete list of the items to be voted upon appears in the letter ballot being sent in a separate mailing to the members. Detailed information concerning most matters referred to letter ballot is given in the committee reports issued in preprint form to the membership in advance of the meeting. The *Summary of Proceedings* accompanying the letter ballot contains a record of all actions taken at the Annual Meeting.

All newly adopted and revised standards will be published in the 1947 Supplements to the 1946 Book of A.S.T.M. Standards. The Supplements will be in five Parts corresponding to the Books of Standards, and the respective Parts will be furnished to the members in accordance with the Parts of the big 1946 Book which they have received. In the meanwhile a number of the standards together with all new tentatives approved at the Annual Meeting or through the Administrative Committee on Standards will be published in some of the special compilations of standards or as separates. Details of the Society's extensive publication schedule are given in another article in this Bulletin.

Sam Tour Award Established

To Stimulate Research and Papers on Corrosion Testing

Through the generosity of Mr. Sam Tour, President of Sam Tour, Inc., New York City, there has been established by his contribution of $1500 an Award which will provide an incentive to undertake research on corrosion testing and to stimulate the preparation of technical papers in this field. The rules of the Award with pertinent information about it, are published below.

In 1946 Mr. Tour completed his quarter century as a member of A.S.T.M., and that year also marked the 25th anniversary of the establishment of Committee B-3 on Corrosion of Non-Ferrous Metals and Alloys. An indication of the donor's interest in the work of Committee B-3 and this whole field of corrosion is his service as Secretary of B-3 for 18 years, then 4 years as Chairman, and at the present time he is also serving as a member of the Advisory Committee on Corrosion. Mr. Tour feels that there is a great deal more to learn about corrosion testing and that because of the importance of the subject it would be very desirable to have some incentive established to stimulate research and the presentation of papers in this field.

The rules governing the Sam Tour Award were approved by the Board of Directors following a report by a special Award Committee headed by Past-President John R. Townsend, and Messrs. W. H. Finkeldey and F. L. LaQue, each of these three men having been very active in many phases of corrosion testing.

It will be noted from the rules that the Award may be a Certificate of Merit, a Medal or cash, as the Award Committee shall decide.

Mr. Tour's Interest in A.S.T.M.:

Mr. Tour had been a member of A.S.T.M. about a year when he was elected Secretary of Committee B-3, serving through 1940, and then he was Chairman for two terms through 1944. His technical interests in A.S.T.M., however, have been widespread. He is a former Chairman of Committee B-7 on Light Metals and Alloys, having served in the period from 1934 to 1944, and he has been an active member of several other committees, particularly in the nonferrous field. A very extensive writer, he has prepared a large number of technical papers and reports. In addition to his many services for A.S.T.M., he has been very active in the work of other professional and technical groups. During World War II he served for some time as Director of Laboratory, Frankford Arsenal.

Rules for Sam Tour Award

1. The Award shall be designated as the Sam Tour Award established for the

purposes of encouraging research on the improvement and evaluation of corrosion testing methods.

2. The Award shall consist of a Certificate of Merit, a Medal, or cash, as the Award Committee may determine from time to time.

3. The Board of Directors shall appoint annually, and not later than September of each year, a Committee on the Sam Tour Award and this Committee shall choose the recipient or recipients of the Award to be made at the following Annual Meeting. The Committee shall consist of not less than three members of the Society; the members of the Administrative Committee on Papers and Publications are not eligible to serve on this Committee.

4. Papers to be eligible for Award shall have been accepted for publication in their entirety by the Society, shall be the bona fide production of those who contribute them and shall not have been previously made public nor contributed elsewhere in whole or in part except in so far as the paper may review for reconsideration data published elsewhere. The following are included among the eligible papers: (*a*) papers accepted by the Administrative Committee on Papers and Publications for any meeting of the Society, including papers to be presented as part of committee reports; (*b*) papers presented at meetings of committees of the Society accepted by said Administrative Committee; (*c*) papers accepted by said Administrative Committee for Publication in the ASTM BULLETIN or any other publication of the Society.

5. Papers shall be reviewed annually for this Award by the above-mentioned Committee of three members of the Society appointed by the Board of Directors not later than September in each year. The Committee shall consist of, for the first year, one member for a term of one year, one member for a term of two years, and one member for a term of three years; in the following year, and each year thereafter, one new member shall be appointed for a term of three years. The Chairman of the Committee in any year shall be the member who retires from the Committee at the end of that year. Members are eligible for reappointment. Members of the Administrative Committee on Papers and Publications shall not serve as members of the Committee on Award.

6. The Committee for each year shall consider all eligible papers scheduled for inclusion in the publications of the year in which the Committee is appointed; the award shall be made at the Annual Meeting in the following year; the Committee's selection of the paper to receive the Award, shall be reported to the Board of Directors not later than April first preceding said Annual Meeting; and the author or authors of the paper selected for the Award shall be notified by the Board of Directors.

7. If in the opinion of the Committee on Award none of the papers under consideration appears worthy of the Award, no Award shall be made for that year and the funds shall be allowed to accumulate as part of the capital account for the Award.

8. In the case of co-authors of an Award paper, each author shall receive equal recognition with respect to the Certificate, Medal, or Cash.

9. The Board of Directors shall have final authority in the management of the funds involved, and should decide any question not specifically covered in these recommendations and make such modifications thereof as may seem desirable.

10. The decision of the Award Committee shall be final.

11. In the event that this Award shall, for any reason, be discontinued, the remainder of the principal of the funds shall be added to the principal of the A.S.T.M. Research Fund.

Personnel of Board of Directors and Committees

THE By-laws of the Society provide that the Board of Directors shall appoint an Executive Committee which will exercise for the Board certain delegated authorities, and provision is made also for the appointment of other committees of the Board covering such phases of the work as membership, inter-society relations, etc. The personnel of the new Executive Committee functioning during 1947–1948 and the six other subcommittees which have been appointed is given below. Preceding this information there is published a complete list of the personnel of the Board of Directors with the titles and addresses of the Directors.

A.S.T.M. BOARD OF DIRECTORS

President:

T. A. BOYD, Head, Fuel Dept., Research Laboratories Div., General Motors Corp., Box 188, North End Station, Detroit 2, Mich.

Vice-Presidents:

R. L. TEMPLIN, Asst. Director of Research and Chief Engr. of Tests, Aluminum Company of America, New Kensington, Pa.

J. G. MORROW, Metallurgical Engineer, The Steel Co. of Canada, Ltd., Hamilton, Ontario, Canada.

Directors:

(Term Expiring in 1948)

J. R. FREEMAN, JR., Technical Manager, American Brass Co., Waterbury 88, Conn.

L. J. MARKWARDT, Asst. Director, U. S. Forest Products Laboratory, Madison 5, Wis.

C. H. ROSE, Chemist, National Lead Co., 105 York Street, Brooklyn 1, N. Y.

L. P. SPALDING, Chief Research Engr., North American Aviation, Inc., Inglewood, Calif.

W. A. ZINZOW, Chief Physicist, Bakelite Corporation, Bound Brook, N. J.

(Term Expiring in 1949)

A. G. ASHCROFT, Director of Research, Alex. Smith and Sons Carpet Co., Yonkers 1, N. Y.

J. H. FOOTE, Supervising Engineer, The Commonwealth and Southern Corp., 212 W. Michigan Ave., Jackson, Mich.

G. C. MACDONALD, Manager, Quality Control Group, Montgomery Ward and Co., 618 W. Chicago Ave., Chicago 7, Ill.

F. E. RICHART, Research Professor of Engineering Materials, University of Illinois, Urbana, Ill.

L. H. WINKLER, Metallurgical Engineer, Bethlehem Steel Co., Inc., Bethlehem, Pa.

(Term Expiring in 1950)

T. S. FULLER, Engineer in Charge of Works Laboratory, General Electric Co., Schenectady 5, N. Y.

E. G. HAM, Technical Director, John A. Manning Paper Co., Inc., Troy, N. Y.

J. J. LAUDIG, Research Engineer, Delaware, Lackawanna & Western Railroad Co., Scranton 5, Pa.

H. L. MAXWELL, Supervisor of General Consultants, E.I. du Pont de Nemours and Co., Inc., 3151 du Pont Building, Wilmington 98, Del.

L. J. TROSTEL, Chief Chemist, General Refractories Co. Laboratories, Box 1673, Baltimore 3, Md.

Past-Presidents:

P. H. BATES, 3835 Livingston Street, N. W., Washington 15, D. C. (Term Expiring in 1948)

J. R. TOWNSEND, Materials Engineer, Bell Telephone Laboratories, Murray Hill, N. J. (Term Expiring in 1949)

A. W. CARPENTER, Manager of Testing Labs., The B. F. Goodrich Co., Akron 11, Ohio. (Term Expiring in 1950)

COMMITTEES OF BOARD OF DIRECTORS

1947–1948

Executive Committee

R. L. Templin, *Chairman*
T. A. Boyd — J. H. Foote
A. W. Carpenter — T. S. Fuller
W. A. Zinzow

Finance Committee

P. H. Bates, *Chairman*
A. W. Carpenter — R. L. Templin
J. R. Freeman — J. R. Townsend

Membership Committee

C. H. Rose, *Chairman*
E. G. Ham — F. E. Richart
H. L. Maxwell — L. P. Spalding

Meetings and Program

F. E. Richart, *Chairman*
J. J. Laudig — C. H. Rose
G. C. MacDonald — L. P. Spalding

Technical Committee Activities

L. J. Markwardt, *Chairman*
J. H. Foote — L. J. Trostel
G. C. MacDonald — L. H. Winkler

Inter-Society Relations

J. G. Morrow, *Chairman*
A. G. Ashcroft — T. S. Fuller
J. R. Freeman — H. L. Maxwell

Developmental Activities

W. A. Zinzow, *Chairman*
A. G. Ashcroft — J. J. Laudig
E. G. Ham — L. J. Trostel

President T. A. Boyd is an *ex-officio* member of these committees.

A.S.T.M. 1948 and 1949 National Meetings

As previously announced, the 1948 Annual Meeting of the Society will be he'd in Detroit dur ng the week of June 21 to 25 inclusive and in conjunction with this will be the Eighth Exhibit of Testing Apparatus, and Related Equipment. Several Detroit hotels will cooperate, but headquarters will be at the Book-Cadillac. The 1948 Committee Week and Spring Meeting will be held in Washington dur ng the week of March 1 to 5. In addition, a number of A.S.T.M. technical committees will either hold group sessions separately or may combine with other committees in the same fields for three or four-day meetings in the fall or spring. While official announcement has not yet been made, it is quite definite that the 1949 Annual Meeting will be in Atlantic City, with the likelihood that Committee Week and Spring Meeting for that year will be in Chicago during the week of February 28 to March 4.

The 1935 Annual Meeting was held in Detroit, and another national meeting of the Society which took place there was the 1940 A.S.T.M. Committee Week and Spring Meeting. Both of these meetings and the numerous local meetings sponsored by the Detroit District Council have been very successful. There is a most active and cooperative group of members in the Detroit area, and all members can look forward to a number of interesting features during the 1948 Annual Meeting.

Schedule of A.S.T.M. Meetings

Date	Group	Place
August 27, 28	Committee C-8 on Refractories	Granville, Ohio
September 4	Administrative Committee on Standards	Philadelphia, Pa.
September 15, 16	Board of Directors	Philadelphia, Pa.
September 16	Subcommittee VII, Committee B-1	New York, N. Y.
September 17	Subcommittee VI, Committee B-1	New York, N. Y.
October 6–9	Committee D-2 on Petroleum Lubricants	Detroit, Mich.
October 8	Detroit District	Detroit, Mich.
October 15, 16, 17	Committee D-13 on Textiles	Philadelphia, Pa.
October 16	Philadelphia District	Philadelphia, Pa.
October 17	Committee B-1 on Wires for Electrical Conductors	New York, N. Y.
November 3–5	Committee C-16 on Thermal Insulating Materials	State College, Pa.
November 3–6	Committees C-1 on Cement, C-7 on Lime, C-9 on Concrete, D-4 on Road Materials	Chicago, Ill.
November 4, 5	Committee D-9 on Electrical Insulating Materials	Atlantic City, N. J.
November 6, 7	Committee D-20 on Plastics	Atlantic City, N. J.
November 10	Advisory Committee, Committee D-1 on Paint, Varnish, Lacquer and Related Products	Atlantic City, N. J.

Committees Honor Hubbard and Clayden

At two dinners in Atlantic City sponsored by A.S.T.M. technical committees two long-time and active A.S.T.M. committee members were honored. Committees D-4 on Road and Paving Materials and D-8 on Bituminous Waterproofing and Roofing Materials joined together and arranged a dinner to recognize the long-time services of Prevost Hubbard who served as secretary of these two committees for a great many years. The dinner was arranged by a committee headed by R. R. Thurston of The Texas Company with Messrs. J. W. Donegan and E. W. Klinger cooperating. E. F. Kelley, Public Roads Administration, was toastmaster. Mr. Hubbard had been Secretary of Committee D-4 from 1908 to 1946 and of Committee D-8 from 1922 to 1946, a record of very intensive service indeed.

The dinner arranged by Committee D-2 on Petroleum Products and Lubricants, which is an annual affair, this year was in honor of A. Ludlow Claydon, Experimental Engineer, Sun Oil Co. Active in the committee work for a great many years, Mr. Claydon was under the general "protection" of Dr. L. C. Beard, Jr., who was Toastmaster, with T. A. Boyd, Past-Chairman as Chief Defender, and T. G. Delbridge, Vice-Chairman, as Chief Razzer. The Dinner Committee headed by S. H. Kurtz, Jr., as chairman, with H. M. Hancock, A. E. Miller, and C. A. Neusbaum assisting, had the following time schedule: Oil for the Lamps at 6.00 p.m.; Fuel for the Furnace at 7.00 p.m., and A Blast of Gas at 8.00 p.m.

Committee D-2 Dinner Group—Honor Guest, Dinner Committee, Officers and Members: Standing, l. to r.: H. M. Hancock, J. B. Rather, J. C. Geniesse, C. A. Neusbaum, W. H. Fulweiler, E. W. Dean, G. G. Oberfell, A. E. Miller, S. S. Kurtz, Jr., W. T. Gunn, Secretary. Sitting, l. to r.: T. A. Boyd; Christian Dantsizen, Chairman; A. L. Clayden, Honor Guest; T. G. Delbridge, Vice-Chairman; H. C. Dickinson, 1946 Honor Guest; L. C. Beard, Jr. About 140 attended the dinner.

District Activities and Personnel

OPERATING under the provisions of the revised Charter for Districts, each of the A.S.T.M. Districts has carried out an election of councilors and on this page are listed the names of councilors elected to serve for terms of two years. For the convenience of members and all who are interested in district activities, there is also given the list of district chairmen, vice-chairmen, and secretaries. These officers carry over through the current year, the elections to fill these offices occurring in the spring of 1948.

The Charter provides that councilors shall be elected by the A.S.T.M. members and committee members in the respective districts, and ballots were distributed in May. All councilors listed on the ballots on the recommendation of the Nominating Committees were elected.

Other District Matters; Philadelphia and New England Meetings

The current report of the Board of Directors includes a table of national A.S.T.M. meetings and those sponsored by the districts. Numerous interesting sessions were held in the 1946–1947 period, and several of the districts already are planning their programs for the coming year. Philadelphia will act as host to the three-day series of meetings of Committee D-13 on Textile Materials, beginning October 15 with a session on October 16 on flammability, followed by dinner, and a more general session in the evening to which will be invited all those in the Philadelphia area concerned with textile materials.

The New England District is planning a technical meeting in Providence, R. I., in late October at which the topic will be textiles. There will be further announcement of the speakers and topics. This meeting is in line with the policy of the New England District to arrange for meetings in various industrial centers in its area.

Through the BULLETIN and by direct mail, the members will be kept advised of meetings planned by the various district councils.

Administrative Matters:

At an extended meeting in Atlantic City, during the A.S.T.M. Annual Meeting, the Administrative Committee on District Activities, headed by C. H. Fellows, Detroit Edison Co., reviewed many matters incident to the functioning and operation of the councils. Procedures in connection with the election of district councilors were clarified. The areas of several of the districts, particularly in the North Central and Northeastern United States, were extended to give practically blanket coverage of the A.S.T.M. membership there. A number of other problems were reviewed, including studies of the annual reports submitted to the Board of Directors by the district councils, in some of which there are recommendations involving Society operations and other details. The results of the Administrative Committee meeting are to be referred to the Board of Directors and will be dispatched to the various district officers and councilors during the summer.

The Administrative Committee serves as an arm of the A.S.T.M. Board of Directors, and supervises the activities of the councils and aids and advises them. Interest in the work of the councils has been growing, and they are aiding and abetting the Society's purposes in many important ways.

A complete list of the district councilors will appear in the 1947 A.S.T.M. Year Book. Many of the councilors' terms carry through 1948 and the list below notes only newly elected councilors and reelections of those whose terms expired in 1947.

Chicago

Chairman: J. J. Kanter, Crane Co., 836 S. Michigan Ave., Chicago 5, Ill.; *Vice-Chairman:* J. de N. Macomb, 105 E. Delaware Place, Chicago 11, Ill.; *Secretary:* G. E. Stryker, Bell & Howell Co., 7100 McCormick Blvd., Chicago 45, Ill.

Councilors: W. L. Bowler, The Pure Oil Co.; C. H. Jackman, Carnegie-Illinois Steel Corp.; A. M. Johnsen, The Pullman Co.; J. E. Ott, Acme Steel Co.; D. D. Rubek, Anderson-Prichard Oil Corp.; Wm. Romanoff,* H. Kramer & Co.; H. B. Knowlton,* International Harvester Co.

Cleveland

Chairman: Arthur J. Tuscany, A. J. Tuscany Organization, Trade Association and Management, 1006 Engineers Bldg., Cleveland 14, Ohio; *Vice-Chairman:* E. G. Kimmich, The Goodyear Tire and Rubber Co., Akron 16, Ohio; *Secretary:* R. T. Bayless, American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio.

Councilors: R. T. Bayless, American Society for Metals; L. T. Herron, The James H. Herron Co.; William Rodgers,* Republic Steel Corp.; Walter Bonsack,* The National Smelting Co.; G. W. Flanigan,* The B. F. Goodrich Chemical Co.; E. G. Kimmich, The Goodyear Tire and Rubber Co.

Detroit

Chairman: V. M. Darsey, Parker Rust-Proof Co., 2177 E. Milwaukee Ave., Detroit 11, Mich.; *Vice-Chairman:* P. Zimmerli, Barnes-Gibson-Raymond Div., Associated Spring Corp., 6400 Miller Ave., Detroit 11, Mich.; *Secretary:* C. E. Heussner, Chrysler Corp., 12800 Oakland Ave., Detroit 31, Mich.

Councilors: A. C. Eichenlaub, Peerless Cement Corp.; C. E. Heussner, Chrysler Corp.; Carl E. Topping,* Consumers Power Co.; Harry Kline, Reichold Chemicals Corp.; Harvey A. Wagner,* Detroit Edison Co.; F. C. Kennedy,* U. S. Rubber Co.

New England

Chairman: H. L. Sherman, Skinner & Sherman, Inc., 246 Stuart St., Boston 16, Mass.; *Vice-Chairman:* V. J. Altieri, Eastern Gas and Fuel Associates, Everett Plant, Everett 49, Mass.; *Secretary:* M. N. Clair, The Thompson & Lichtner Co., Inc., 8 Alton Place, Brookline 46, Mass.

Councilors: H. J. Ball, Lowell Textile Inst.; A. V. Bratt, Boston Dept. Public Works; R. W. Chadbourn, Boston Edison Co.; Kenneth B. Cook,* Crown Mfg. Co.; Randall H. Doughty,* Fitchburg Paper Co.; H. D. Evans,* Pepperell Mfg. Co.; A. A. Klein,* Norton Co.; Alex Morrison,* American Woolen Co.; H. L. Sherman, Skinner & Sherman Inc.; Arthur L. Shields,* Westinghouse Elec. Corp.

New York

Chairman: Myron Park Davis, Otis Elevator Co., 44 Wells Ave., Yonkers 1, N. Y.; *Vice-Chairman:* E. A. Snyder, Socony-Vacuum Oil Co., Inc., 26 Broadway, New York 4, N. Y.; *Secretary:* G. O. Hiers, National Lead Co., 105 York St., Brooklyn 1, N. Y.

Councilors: G. J. Comstock, Stevens Institute of Technology; Myron Park Davis, Otis Elevator Co.; C. A. Hescheles, United States Rubber Co.; H. J. Jaquith, Minot, Hooper and Co.; W. J. Krefeld, Columbia University; P. S. Kingsley, General Electric Co.; P. J. Witte, New York City, Dept. of Purchase; L. T. Work, Metal and Thermit Corp.; A. A. Jones,* Anaconda Wire and Cable Co.

Northern California

Chairman: Dozier Finley, The Paraffine Cos., Inc., 2725 Ashby Place, Berkeley 5, Calif.; *Vice-Chairman:* G. H. Raitt, Steel Tank & Pipe Co. of Calif., 1100

As this BULLETIN *nears press the Detroit District advises of a meeting on October 8 on the Subject "Petroleum Products as Related to Automotive Equipment," during the meetings of Committee D-2 in Detroit.*

Fourth St., Berkeley 2, Calif.; *Secretary:* P. V. Garin, Southern Pacific Co., 65 Market St., San Francisco 5, Calif.

Councilors: P. V. Garin, Southern Pacific Co.; F. M. Harris, Pacific Gas and Electric Co.; R. A. Kinzie, Santa Cruz Portland Cement Co.; M. C. Poulsen, Port Costa Brick Works; F. D. Tuemmler, Shell Development Co.; G. L. von Planck, Columbia Steel Co.; F. C. Cook,* Robert W. Hunt Co.; John G. Little,* Bureau of Building Inspection, City and County of San Francisco; Samuel A. Abrahams,* Plant Rubber and Asbestos Works; Thomas E. Stanton,* State of California Division of Highways; L. Mittelman,* Tide Water Associated Oil Co.; L. A. O'Leary,* W. P. Fuller & Co.

Philadelphia

Chairman: J. F. Voges, Jr., 315 Broad Street Station, Philadelphia 2, Pa.; *Vice-Chairman:* A. O. Schaefer, Midvale Co., Nicetown, Philadelphia 40, Pa.; *Secretary:* G. E. Landt, Philadelphia Textile Finishers, Inc., Ford and Lafayette Sts., Norristown, Pa.

Councilors: G. E. Landt, Philadelphia Textile Finishers, Inc.; W. T. Pearce, Consultant on Organic Coatings; A. O. Schaefer, The Midvale Co.; E. K. Spring, Henry Disston and Sons, Inc.; L. H. Winkler, Bethlehem Steel Co., Inc.; R. A. Lukens,* Continental Mills, Inc.; D. T. Corning,* City of Philadelphia, Bureau of Highways; H. S. Phelps,* The Philadelphia Electric Co.; J. J. Duffy, Jr.,* Pennsylvania Salt Mfg. Co.; R. P. Heuer,* General Refractories Co.

Pittsburgh

Chairman: J. J. Bowman, Aluminum Company of America, 801 Gulf Bldg., Pittsburgh 19, Pa.; *Secretary:* M. D. Baker, West Penn Power Co., Box 98, Springdale, Pa.

Councilors: J. J. Bowman, Aluminum Company of America; Dean Harvey, Consultant on Materials; P. G. McVetty, Westinghouse Electric Corp.; J. J. Paine, City of Pittsburgh; Thomas Spooner, Westinghouse Electric Corp.

St. Louis

Chairman: A. W. Brust, Washington University, Box 83, St. Louis 5, Mo.; *Secretary:* S. B. Roberts, Robert W. Hunt Co., 1403 Syndicate Trust Bldg., St. Louis 1, Mo.

Councilors: A. W. Brust, Washington University; J. C. Hostetter, Mississippi Glass Co.; F. V. Reagel, Missouri State Highway Dept.; H. von Schrenk, Consulting Timber Engineer; J. M. Wendling, City of St. Louis Municipal Research Testing Laboratory; J. L. Hamilton,* Century Electric Co.; W. W. Horner,* Consulting Engineer; W. C. Magruder,* Carter Carburetor Co.; R. W. Notvest,* National Bearing Div. American Brake Shoe Co.; E. J. Sheppard,* National Lead Co.; H. F. Thomson,* General Material Co.; G. H. von Fuchs,* Shell Oil Co.; E. P. Buxton,* Western Cartridge Co.

Southern California

Chairman: R. B. Stringfield, Consulting Chemical Engineer, 229 S. Normandie Ave., Los Angeles 4, Calif.; *Vice-Chairman:* C. E. Emmons, The Texas Company, 929 S. Braodway, Los Angeles 15, Calif.; *Secretary:* H. W. Jewell, Pacific Clay Products, 306 W. Avenue 26, Los Angeles 31, Calif.

Councilors: C. E. Emmons, The Texas Company; E. F. Green, Axelson Manufacturing Co.; R. E. Paine, Aluminum Company of America; E. O. Slater, Smith-Emery Co.

Western New York-Ontario

Chairman: T. L. Mayer, Department of Technology, Buffalo Public Library, Buffalo 3, N. Y.; *Vice-Chairman:* O. W. Ellis, Ontario Research Foundation, 43 Queen's Park, Toronto 5, Ont., Canada; *Vice-Chairman:* Leon V. Foster, Bausch & Lomb Optical Co., 635 St. Paul St., Rochester 2, N. Y.; *Secretary:* Joseph Gentile, Pittsburgh Testing Laboratory, 257 Franklin St., Buffalo 2, N. Y.

Councilors: D. D. Crandell, National Co.; W. P. Dobson, Hydro-Electric Power Commission of Ontario; W. J. Rother, Buffalo Foundry and Machine Co.; Louis Shnidman, Rochester Gas and Electric Corp.

* New Council members.

District Meetings Held on Radar and on Gasoline

Two of the A.S.T.M. Districts sponsored meetings in May, one in New York on May 27 featuring the subject "Radar," the other in Pittsburgh on May 19 featuring an address by President T. A. Boyd, Head, Fuel Department, Research Laboratories Division, General Motors Corp., Detroit, on the subject "Gasoline—Yesterday, Today, Tomorrow." A few notes on these meetings follow.

New York—Radar:

Captain Ernest G. Atkins, who has been very closely associated with radar for a number of years and who is Chief of the Radar Laboratory, Watson Laboratories, Air Matériel Command, Army Air Forces, located at Red Bank, N. J., gave a most interesting talk, describing in non-technical language the development of this potent wartime weapon which, however, has important peacetime applications. He described the variety of components and sets which gradually were evolved and stressed the tremendous improvement made under war pressure. As capacities were increased, better materials and components were required. In some cases parts had to be developed which would give outputs 100 or 1000 times greater than what had been available. He paid tribute to A.S.T.M. for making available its specifications and tests.

The film he exhibited showed the operation of a radar set, in this case a GCA set, bringing a large plane down through the clouds and fog and landing safely. To do this required a formidable setup of equipment with about five operators, but the success and efficiency of the equipment were uncanny.

Myron Park Davis, Chairman of the New York District, introduced C. T. Hatcher, the program chairman, who presented the speaker. There were about 160 in attendance at this meeting.

Pittsburgh—Gasoline:

The Pittsburgh District Council had invited Vice-President, now President, T. A. Boyd, Head of the Fuel Department, Research Laboratories of General Motors, to speak at its meeting at Mellon Institute on May 19, and the some 160 members and guests present heard his most interesting address on "Gasoline—Yesterday, Today, Tomorrow." In his address, a synopsis of which was published in the May BULLETIN, Mr. Boyd described gasoline in relation to five properties: (1) supply; (2) cost; (3) vaporization; (4) energy content; (5) knock rating. He painted an interesting historical picture and stressed the important part that research has played in making available not only the tremendous quantities of gasoline now required but improvements in quality to meet engine needs. A.S.T.M. Technical Secretary R. E. Hess also spoke at the meeting, noting some of the newer Society projects in standardization and research. District Chairman J. J. Bowman presided.

Pacific Chemical Exposition

THE Northern California District Council has accepted an invitation to sponsor a booth display featuring A.S.T.M. publications and activities in the 1947 Pacific Chemical Exposition being held in San Francisco October 21–25. Earlier in the year this group arranged to man and set up a booth in the Western Metals Exposition and a display in the Chemical Show will stress a number of phases of A.S.T.M. work in these fields. Mr. Dozier Finley, Chairman of the Northern California group, and P. V. Garin, Secretary, are handling details.

New Committee on Engine Antifreezes Organized

THE use of high compression engines and changes in the cooling systems of automobiles and other types of automotive equipment in recent years have resulted in an increasing interest in engine antifreeze materials and coolants. There has accordingly been a need for the standardization of various test methods for the examination and evaluation of antifreeze materials. The problems have been further complicated by the introduction of various concentrates and anticorrosion additives and inhibitors used in connection with antifreeze materials. There has been need, for example, for test methods to determine the freezing point of antifreeze materials, and the subject of corrosion is most important. In connection with the freezing-point problem, the matter of servicing and checking automobile cooling systems at service stations would need to be considered. Since antifreezes are of direct interest to the ultimate consumer, any standardization work would need to include performance specifications, which would be of immediate utility so far as the user is concerned. While consideration of the many problems indicated the need for standardization work to be undertaken, it was realized that progress in attaining the desired objectives might be slow.

After investigation of the desirability of undertaking work in this field, the Board of Directors authorized the organization of a new Committee D-15 on Engine Antifreezes. This committee held its organization meeting at Buffalo, N. Y., on May 26, 1947. At this meeting permanent officers were elected. The officers and present membership of the committee are listed below:

At the organization meeting an Advisory Committee of seven members was also elected consisting of the following:

H. R. Wolf, Chairman
D. G. Zink, Vice-Chairman
E. H. Keller, Secretary
D. B. Brooks
J. D. Klinger
L. W. Vollmer
R. A. Willihnganz

The committee will function under the following statement of scope:

Scope.—The Study of Engine Antifreezes—This will include terminology, identification and classification, methods of sampling and testing of *engine antifreezes and cooling system corrosion inhibitors:* interpretation and significance of tests; and the preparation of specifications.

At the organization meeting consideration was given to specific projects and problems that need attention. This resulted in suggestions for the following 19 subjects that might be included in the program of work to be undertaken by the committee:

1. Freezing point
2. Boiling point (at various pressures)
3. Reserve alkalinity and pH
4. Corrosion
5. Foaming
6. Methanol, ethanol, and ethylene glycol
7. Water content
8. Rate of evaporation
9. Ash and solids on evaporation
10. Specific heat, specific gravity and viscosity at −80 to −100 F., heat transfer
11. Rubber swelling
12. Storage stability
13. Chemical composition
14. Performance test (road testing)
15. Appearance (color)
16. Cooling system and gum and sludge formation including antileak materials
17. Leakage and creepage rates
18. Accuracy of commercial hydrometers
19. Motor tests

The committee decided to refer these suggestions to the Advisory Committee for review and study and for use as a basis for establishing subcommittees (see below).

At the conclusion of the organization meeting, the committee, on the invitation of D. H. Green of the National Carbon Co., visited the laboratories of the Linde Air Products Co.'s Research Laboratory of the Carbide and Carbon Chemicals Corp. located at Tonawanda, N. Y. Prior to the visit through the laboratories, Mr. Green presented a brief summary of the types of investigative work carried on at the laboratory. A very interesting paper on "Problems of Automotive Cooling System Corrosion Inhibition" was also presented by Mr. Willihnganz. This paper dealt with (1) the corrosion problems encountered in automotive cooling systems, (2) some test methods used in evaluating this corrosion, (3) different factors affecting the corrosion of automotive cooling system metals, and (4) certain types of inhibitors found effective in minimizing this corrosion.

PERSONNEL OF TECHNICAL COMMITTEE D 15

Chairman: H. R. Wolf, Research Laboratories Div., General Motors Corp., Box 188, North End Station, Detroit 2, Mich.

Vice-Chairman: D. G. Zink, U. S. Industrial Chemicals, Inc., 60 E. Forty-second St., New York, N. Y.

Secretary: E. H. Keller, E. I. du Pont de Nemours and Co., Inc., Ammonia Dept., Wilmington 98, Del.

GI H. F. Brinen, Young Radiator Co.
GI D. B. Brooks, National Bureau of Standards
C Chrysler Corp., J. D. Klinger
P A. L. Clayden, Sun Oil Co.
P Commercial Solvents Corp., W. L. Keko
P T. R. Donlan, Standard Oil Co. of N. J.
P The Dow Chemical Co., H. S. Nutting
P E. I. du Pont de Nemours and Co., Inc., F. J. Funk and E. H. Keller
C Ford Motor Co., B. E. Tiffany
C General Motors Corp., H. R. Wolf
GI The B. F. Goodrich Co., C. W. Brees
P William S. Gray and Co., D. R. Chamberlain
P-C Gulf Research & Development Co., L. W. Vollmer
P The Linde Air Products Co., R. A. Willihnganz
C Montgomery Ward & Co., L. M. Schilb
P National Carbon Co., Inc., D. H. Green
GI National Research Council of Canada, D. Wolochow
C Packard Motor Car Co., R. E. VanDeventer
P Publicker Industries, Inc., Nathan Lacktman
C Public Service Electric and Gas Co., W. L. Jackson
C Sears, Roebuck and Co., M. L. Fierke
P-C Shell Oil Co., Inc., E. G. Travis
P-C Socony-Vacuum Oil Co., Inc., R. B. Killingsworth
P-C Standard Oil Co. of Indiana, R. E. Vogel
P The Texas Company, Gus Kaufman
P U. S. Industrial Chemicals, Inc., D. G. Zink
C U. S. Navy, Bureau of Ships, Code 350
C U. S. War Dept.:
Army Air Forces, D. M. Benson and E. M. Glass,
Ordnance Dept., G. G. Allan and V. O. Hatch

SUBCOMMITTEES

The D-15 Advisory Committee held a meeting in Philadelphia, Pa., on July 8, 1947, and after careful review of the various subjects suggested at the organization meeting, action was taken appointing the following six subcommittees:

Subcommittee I on Freezing Point Determination—D. B. Brooks, chairman.

Subcommittee II on Hydrometers for Field Testing—J. D. Klinger, chairman.

Subcommittee III on Physical Properties—H. S. Nutting, chairman.

Subcommittee IV on Chemical Properties—R. A. Willihnganz, chairman.

Subcommittee V on Effect of Antifreeze on Rubber Hose:—chairman to be appointed.

Subcommittee VI on Simulated and Actual Service Testing—E. H. Keller, chairman.

Consideration was also given to various other matters such as definitions of terms covering antifreeze materials and various inhibitors, and the need for specifications. It was decided that work should first be initiated on the various methods of test that will be required in evaluating these materials. It is planned to give consideration to additional subcommittees at a later date.

Committee to Be Formed on Structural Sandwich Constructions

THE FORMATION of a new technical committee on Structural Sandwich Constructions has been authorized by the Board of Directors based on the recommendations of a special study committee. This study committee was appointed following a conference held on June 7, 1946, at which the problems in this growing field were discussed and the need of further study stressed.

The study committee consisted of L. J. Markwardt, chairman, U. S. Forest Products Laboratories; R. B. Crepps, Owens-Corning Fiber Glass Corp.; J. M. Frankland Chance-Vought Aircraft Division of the United Aircraft Corp.; G. M. Kline, National Bureau of Standards; R. C. Platow, Bell Telephone Laboratories; G. M. Rapp, John B. Pierce Foundation, and R. L. Templin, Aluminum Company of America. During the past several months the committee has reviewed and analyzed the comments and recommendations recorded at the June 7 conference and have conferred with other persons and groups interested in this field, including interested committees of the Society. A comprehensive report was prepared and presented to the Board of Directors, which concluded with the following four recommendations:

"1. That consideration of sandwich construction problems by the Society be limited for the present to 'structural sandwich' constructions;

"2. That a committee on 'structural sandwich constructions' be established within the Society as soon as practicable, to be responsible for problems relating to structural sandwich constructions. So far as possible this committee should call on existing technical committees for test procedures and specifications relating to individual component materials. When the need arises for test methods and specifications on a component material not within the scope of existing committees, the new committee should proceed independently to meet its own problem with respect to its own field of work;

"3. That the Committee on Structural Sandwich Constructions develop such test methods and specifications for sandwich constructions as may be necessary, including not only methods for mechanical tests, but also methods for other tests such as durability, using the existing facilities of other technical committees as far as possible; and

"4. That the Committee on Structural Sandwich Constructions give consideration to the needs for simulated service tests and tests of end products in this field."

NOTE—These recommendations are included in the Annual Report of the Board of Directors presented at the Fiftieth Annual Meeting of the Society at Atlantic City, N. J., June 16–20, 1947.

The special study committee has been continued in order to advise the President and Executive Secretary of the Society in the selection of personnel, determination of scope, and the relationship to be established between the new committee and the present committees of the Society dealing with the various constituent materials of sandwich constructions.

When the new committee is formally organized, a suitable news account will appear in the BULLETIN.

New Committee Organized on Magnesium Oxychloride Cement Materials

MAGNESIUM oxychloride cements have been used in the construction field for many years. Their principal usage has been as an interior flooring or a base for interior flooring surfaces such as asphalt tile or terrazzo. Down through the years there has been some uncertainty as to the quality and serviceability of the final product in place. This has been due to the lack of standardization, and resulting lack of control, of the major constituents incorporated in a flooring mixture, which are chiefly magnesium oxide and magnesium chloride.

The Society has been cognizant of the need for standardization work in this field for some time, but the war interrupted efforts in this direction. During the past year, however, this subject was again activated and, upon authorization of the Board of Directors, a new technical committee has been organized known as Committee C-2 on Magnesium Oxychloride Cements.

The organization meeting was held on May 22, 1947, at the National Bureau of Standards, in Washington, D. C., and was marked by the eagerness of those present to initiate action in this field as soon as possible. The election of permanent officers and the completion of the initial organization was effected at this meeting. Dr. L. S. Wells, National Bureau of Standards, was elected Chairman; Dean Hubbell, Mellon Institute Vice-Chairman; and G. J. Fink, Oxychloride Cement Association, as Secretary. The initial organization consists of an executive subcommittee composed of

the officers and subcommittee chairmen; a subcommittee on methods of test, consisting of five members, with W. J. Riley, Westvaco Chlorine Products Corp., as Chairman; and a subcommittee on specifications and definitions, with a membership of six, and with E. H. Dhein, U. S. Corps of Engineers, as temporary Chairman.

The statement of scope will cover the formulation of specifications, methods of testing, and definitions relating to magnesium oxychloride cements, and research.

A round-table discussion centered around projects that should be included in the initial program of the committee. A résumé of the discussion emphasized in particular that the committee shou'd formulate tests on properties of the individual ingredients as well as on the finished product. Change of volume was recognized as a very important property to study. Among other points cited was the need for a short testing procedure on the finished product, a resiliency test, and good performance standards. It was felt that the committee should explore all possible uses of this material and that its field of endeavor should not overlook other existing uses, in addition to flooring, such as stucco and master molds for castings.

The initial membership of the committee is indicated below:

C American Railway Engineering Association—L. M. Morris (Pennsylvania Railroad Co.)

P The Dow Chemical Company—Herman H. Miller, Magnesia Cements Lab.

P Hill Brothers Chemical Company—C. B. Hill

P Kompolite Company, Inc.—Frank Jaros

GI National Bureau of Standards—Dr. L. S. Wells (Chairman)

C National Housing Agency—Francis K. Wilson

C The City of New York—Wm. S. Elliott, Chief, Mats. Section, Dept. of Public Works

P Oxychloride Cement Association, Inc. —G. J. Fink (Secretary)

C Public Buildings Administration—Henry H. Waples, Architectural Engr.

P H. H. Robertson Co.—Dean Hubbell, Senior Fellow, Mellon Inst. of Industrial Research (Vice-Chairman)

P F. E. Schundler & Co., Inc.—P. S. Denning, Technical Director

C U. S. Navy Dept., Bureau of Yards & Docks—C. J. Ebert (Code D-5-3C)

C U. S. War Dept., Corps of Engineers—E. H. Dhein

C Veterans Administration—W. R. Von Blon, Chief of Lab., Construction Service

P Westvaco Chlorine Products Corp.—W. J. Riley

Organization of Sectional Committee ASA-A88 on Magnesium Oxychloride Cement Flooring

Sectional Committee A88 on Magnesium Oxychloride Cement Flooring was organized on June 19, 1947, at Atlantic City, N. J., during the week of the A.S.T.M. Annual Meeting, under the procedure of the American Standards Association, with the Society as a joint sponsor with the National Bureau of Standards. This committee will function very closely with the recently organized Committee C-2 on Magnesium Oxychloride Cements, announced in this Bulletin, and has considerable overlapping personnel. The sectional committee will confine its attention to magnesium oxychloride cement flooring and its installation, whereas the A.S.T.M. committee is primarily concerned with the materials that constitute the cement, as used for any purpose.

The scope adopted by the committee is:

Scope: Specifications and methods of tests on materials for magnesium oxychloride cement flooring, and specifications covering the installation of such flooring.

Election of permanent officers took place with J. C. Thornton, The Detroit Edison Co., elected as Chairman; Dean Hubbell, Mellon Institute, Vice-Chairman; and G. J. Fink, Oxychloride Cement Association, Secretary. Four subcommittees were authorized, consisting of an executive subcommittee composed of the officers and other subcommittee chairmen; a specifications subcommittee, with W. J. Riley, Westvaco Chlorine Products Corp., as Chairman; a subcommittee on performance tests, with Dean Hubbel , Mellon Institute, as Chairman; and a small subcommittee of three members, on reports, with Frank Jaros, Kompolite Co., as Chairman. The initial work of this committee will stress specifications on flooring and installations, and in particular the study of the effect of temperature of installation, humidity, setting time, wear tests, and cracking or shrinkage effects.

A.S.T.M. Book of Standards Available in Canada

As a convenience for those who wish to procure the 1946 Book of A.S.T.M. Standards in Canada, the Canadian Standards Association will keep in its files several complete copies of the 1946 A.S.T.M. Book. Arrangements have recently been made to ship a supply of the current Book of Standards to the C.S.A. offices, National Research Building, Ottawa, and any or all Parts of the Book will be available for prompt shipment to any parts of Canada.

The prevailing list price for the Book will be in effect. Thus it is expected that those members who wish to take advantage of the special members' prices will continue to order their publications from the A.S.T.M. Headquarters office.

The Canadian Standards Association has held membership in A.S.T.M. for many years. Col. W. R. McCaffrey is Secretary of the C.S.A., and A.S.T.M. Vice-President J. G. Morrow, Steel Company of Canada, has for a number of years been Chairman of the Association.

The Association has available for distribution in Canada copies of British Standards and also various standards that have been approved under the sponsorship of the American Standards Association.

Some Current Standardization Projects in Technical Committees

Much Activity Under Way on Numerous Materials

It is considered very worth while to include in each August issue of the ASTM Bulletin a "round-up" of important standardization activities which may be under way in the various technical committees. The material which follows provides some conception of these. The information is based in part on current reports of the technical committees, and in large measure on statements of programs of work which the technical committee officers have been asked to send to Headquarters. Much of this information is of interest to the membership broadly, and it is a great help to the Staff and to the Administrative Committee on Standards in providing a look-ahead.

Arrangement of Material

The material which follows is arranged in general in the order of the designations of the Technical Committees, the "A" and "B" groups, Ferrous and Non-Ferrous appearing first, followed by the "C" and "D" groups. However, the latter statements are broadly divided according to "constructional" and "nonconstructional" materials.

Ferrous and Non-Ferrous Metals—"A" and "B" and Some "E" Committees

Steel

Culminating rather intensive work in the spring of this year, Committee A-1 on Steel at the Annual Meeting asked approval for publication of seven new tentative specifications, as noted in another article in this Bulletin, which lists all new and extensively revised tentatives. Some projects on which work will be concentrated during the coming year are: The development of a document which would provide in one place tables of permissible variations, tolerances, and related information and data on requirements which are common to various structural steel specifications. The objective is to provide through this document complete information so that Specification A 7 covering structural steel, for example, would be complete in practically all respects. The Advisory Committee of Committee A-1 has asked Subcommittee II to present a suggested document for consideration. A new section is being organized on hot-formed springs and work will continue in connection with certain specifications for bar steels, including one on stress-relieved annealed cold-drawn carbon steel bars.

A number of modifications in several specifications for forgings are to be developed somewhat similar to those which were approved at the Annual Meeting involving the railroad forgings specifications. In the work on materials for high-temperature service, Subcommittee XXII has the usual number of activities, perhaps of paramount interest the work on steel castings where a number of new grades are being proposed.

Cast Iron

During the past year Committee A-3 has given considerable thought and attention to increasing its activities in cooperation with other organizations, such as the American Foundrymen's Association, that are interested in cast iron. A Research Advisory Group has been appointed to investigate and give some guidance on research problems—such as stress analysis and there is an active subcommittee working on gray iron specifications of limited life for temperatures up to 1400 F. in non-pressure service. This committee is formulating a tentative specification which should be completed during the coming year.

Corrosion of Iron and Steel

For some years past there has been an increased concentration of work in Committee A-5 in its Subcommittees VI on Specifications and VIII on Field Tests. To equalize this burden, each of these committees has been split into three, with separate subcommittees on specifications for sheets, wire, and hardware, and on exposure testing for the same three categories: the work formerly covered by Subcommittee III on Inspection of the Annapolis Tests has been combined with that of the exposure testing of the other sheet material.

The Subcommittee on Wire Specifications will investigate the need for specifications for chain-link fence fabric galvanized before weaving.

It is of interest to note that Committee A-5 has voted to turn over to Committee B-8 responsibility for the Specification for Electrodeposited Zinc Coatings on Steel (A 164 – 40 T), but is retaining jurisdiction over specifications for products carrying zinc coatings.

Magnetic Properties

Committee A-6 has recently reviewed a new list of International Electrotechnical letter symbols which has been suggested by the United States National Committee of the International Electrotechnical Commission. A number of magnetic symbols are not in agreement with the symbols used in Standard Definitions A 127. The committee is protesting the adoption of the proposed international symbols. Proposals have also been received for alterations and additions to the permeability specifications dealing with permanent magnet materials. Further work is being done on the use of the 25-cm. Epstein specimen for d-c. permeability tests. It is expected that a standard method of test will result soon.

At a recent meeting of Committee A-6, a paper was presented describing a machine developed by the General Electric Co. for testing core plate enamel, and consideration is being given to the advisability of writing a standard covering this method.

A new subcommittee has been established on coordinating magnetic testing equipment and methods which has arranged to have a number of check samples prepared. These will be interchanged among various laboratories from time to time, in order to determine whether or not any laboratories are out of line with reference to the expected tolerances as covered by Standard Methods A 34. The National Bureau of Standards is cooperating in these tests.

Malleable Iron

The scope of Committee A-7 has recently been changed to include research activities and plans have been made for some investigation work during the coming year which will be designed to clarify methods of testing as applied to the various types of malleable iron. Special consideration will be given to the results in light of the definition of the terms "Yield Point" and "Yield Strength" as they appear in Designations E-6 and E-8.

The Specifications for Malleable Iron Flanges, Pipe Fittings, and Valve Parts (A 277 – 44 T) has been a recurring topic of discussion on the part of the committee, with the long-range opinion being quite generally divided as to its value, particularly as now worded. A special committee has been appointed which will endeavor to develop a solution during the coming twelve months.

Iron-Chromium-Nickel and Related Alloys

Committee A-10 has just completed a set of tables covering the properties of cast heat- and corrosion-resisting alloys. These tables, together with the revision of the present tables on the wrought chromium and chrome-nickel steel including addenda on the properties of these alloys at low temperatures, will be published by the Society shortly.

Also receiving attention is the development of metallographic methods of the identification of sigma phase in iron-chromium and iron-chromium-nickel stainless steels to include both wrought and cast materials. Samples are available for distribution to members of the subcommittee, and it is expected the work will be delegated shortly to eight or ten laboratories. X-ray, impact tests, permeability, and various etching techniques will be used.

The committee is also studying suggestions received that the stainless steels AISI types 316 with columbium, 317 and 405 be included in specification for flat products under A 240. It is also considering the substitution of a flat 8-in. specimen of full section of plate over $\frac{1}{2}$ in. in thickness as an alternate for the 2-in. gage length round test specimen presently required in Specifications A 167, A 176, and A 240.

Wires for Electrical Conductors

During the past year, the scope of the work of Committee B-1 was enlarged from copper and copper alloys to conductors of all types of material. This brings under the jurisdiction of this committee such materials as copper-covered steel, aluminum and composite conductors, etc. To handle this increased activity, the committee has been organized into seven standing subcommittees, several of which have task groups appointed for specific projects.

A study is to be made of existing specifications with respect to methods of test and sampling procedures and those that apply to several specifications are to be extracted and covered by separate documents. Revision of the present method of test for resistivity is also under way.

Proposals are to be drawn on the determination of area, weights, and resistivity of completed copper and copper alloy conductors. The agenda includes consideration of the needs for specifications covering copper conductors with a fiber or other core, and the relaxation of tensile-elongation values of individual wires removed from stranded cable. In the field of copper-covered wires and cables and composite conductors of copper and steel, new specifications will be prepared. These are to cover copper-covered steel wire, copper-covered steel stranded conductors, copper-covered steel and copper composite, and conductors of copper and steel. In the field of conductors of light metal, which likewise have no Society specifications, new standards will be prepared, covering aluminum wire, all-aluminum stranded cable, and aluminum cable steel reinforced. Prompt action is contemplated on all these new specifications.

Non-Ferrous Metals and Alloys

Committee B-2 will continue active work on specifications including the revision of the two specifications for fire-refined copper, B 72 and B 216, which have been completed by the subcommittee and are now out to letter ballot in the committee. A new specification for antimony is about completed. A study of the commercial status of the production and sale of tin at the present time is being undertaken to determine what should be done about a specification for this metal. Minor changes are contemplated in the specifications for solder (B 32) and for babbitt (B 23) and will be submitted to the A.S.T.M. Administrative Committee on Standards.

The subcommittee on coated metals is continuing its investigation of the specification for lead-coated copper sheet (B 101), whether it should be amended or withdrawn. The subcommittee on refined nickel and nickel alloys has been particularly active and expects to complete revision of several specifications, including those for plate, sheet, and strip (B 127) and for rods, bars, and forgings (B 164).

Corrosion of Non-Ferrous Metals and Alloys

One of the principal activities in Committee B-3 during the next year will be a further inquiry into the subject of weather and weather data with the object of correlating available information with the results of atmospheric exposure tests. A new subcommittee on humidity testing is starting the development of a method. The stainless steel couples which have been on exposure for five years were removed in 1946, and the report on the results obtained in this test is now being compiled and will be included in the 1948 report. Magnesium coupled with various other metals and alloys is being assembled and will shortly be placed on exposure. A subgroup has been formed to carry out cooperative total immersion tests to determine whether the Tentative Method B 185 will give consistent results.

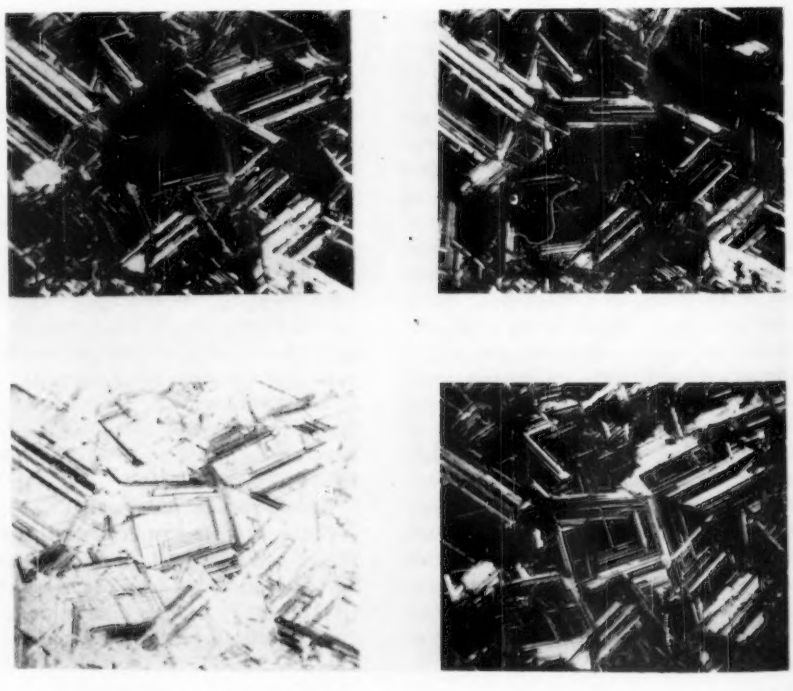
Electrical Heating, Resistance, and Related Alloys

There is continued active interest in the radio field in Committee B-4, with particular reference to the evaluation of the emissivity of cathode nickel. These studies include the effect of very minor impurities in the cathode, the effect of coating and of particle size in the coating. Considerable data have been accumulated to date and these will soon be reflected in new test methods and standards.

It is proposed to expand the Specification for Nickel-Chromium-Iron Alloy

Hastelloy B, ×1000. Series of four pictures, same subject, taken by white light and by polarized light at various angles.

First prize-winning photograph, photomicrographic section, in the Fifth A.S.T.M. Photographic Exhibit, by R. T. Knaggs, General Electric Co.



Castings for High Temperature Service (B 207) to include the 38 nickel–18 chromium composition as well as the 35–15 class. Other subjects under active study in Committee B-4 are: investigation of the test methods for determining the comparative performance of mounted thermostat elements and tests for hardness of thermostat metals; and an investigation of the causes and prevention of "green rot" in electric furnaces using controlled atmospheres; and electrical characteristics of contact materials.

Copper and Copper Alloys, Cast and Wrought

Committee B-5 has completed a very active year of work in specification revision, but still has a considerable amount of work mapped out for it during the coming twelve months. The requirements for the physical properties of beryllium-copper sheet and wire in Specifications B 194, B 195, and B 197 are being reviewed.

Among other suggestions being studied are the broadening of the scope of the copper rod specifications (B 133 and B 187) and the possible deletion of the bend test requirements now given therein, as well as the application of the new tentative Method of Tension Testing of Copper and Copper Alloy Rods (B 220). The committee is also reviewing hydrostatic and pneumatic testing requirements in pipe and tube specifications, the development of requirements for dehydrated and sealed tubes in Specifications B 68, and the incorporation of minimum values for additive elements for Admiralty metal and aluminum brass in the condenser tube specification (B 111).

The subcommittee on castings and ingots for remelting has been relatively inactive during the past year pending the availability of data on test bars. But with the promise that such data will all be in hand within the next few months, renewed activity is anticipated. The sampling procedures in the specifications for ingot (B 30) and for phosphor-copper (B 52) and for silicon copper (B 53) are also being reviewed.

The subcommittee on methods of test is studying the development of a bend test method for rods and bars, preparation of a standard referee clause, the effect of speed of testing on tensile properties, the relation of Rockwell hardness to thickness of specimen, and the development of methods of tension testing for thin sheet metals.

Among the subjects being studied by the subcommittee on tolerances are the revision of length and straightness tolerances in Specifications B 187, the revision of diameter tolerances in Specifications B 138, and, in collaboration with CABRA, the revision of tolerances in Specifications B 111 and the development of methods for measuring the straightness of shafting and piston-finish rod.

The subcommittee on editorial and publications is continuing its study of the chemical limits and of the nomenclature and classification of wrought alloys under the jurisdiction of the committee.

Classification of Coppers

During the year just past, a joint committee, composed of representatives of Committees B-1, B-2, and B-5, was established by the Non-Ferrous Coordinating Committee to attack the long-standing problem of writing a classification of coppers. Under the leadership of Sidney Rolle as chairman, this committee during the past year has made considerable progress and it is expected that the classification will take final form in time to be included in the 1947 Supplement of the Book of Standards.

Die-Cast Metals and Alloys

Committee B-6 has under consideration for adoption the addition of a third alloy to the Tentative Specifications for Copper-Base (Brass) Alloy Die Castings (B 176). This alloy will be known as Alloy C and have a nominal composition of 82 per cent copper, 4 per cent silicon, and 14 per cent zinc. Work is also under way to determine certain mechanical and physical properties such as compressive and shear strength, thermal and electrical conductivity, etc., for all the alloys covered in B 176.

The subject of the speed of testing and its application to various specifications of the committee continues to be one of active interest and a new subcommittee on die casting processes has been organized to take over the work of the former special research committee which, during the past year, has been planning studies to determine the effects of die-casting variables.

Light Metals and Alloys, Cast and Wrought

During the past year, Committee B-7 has written a number of new specifications for aluminum alloys and reviewed the entire field of their aluminum and magnesium specifications to bring them thoroughly up to date. Although most of this work is now completed, amendments to several specifications are still contemplated, and it is expected that a new Specification for Aluminum Bus Bars will be written during the coming year.

In this committee also the subject of the speed of testing is under active consideration, as well as the determination of elongation of sand-cast light alloy test bars. Recently attention has also been directed to new nondestructive test methods for the determination of the thickness of anodic coatings of aluminum.

Study of the code system for aluminum alloys still continues. There is evidence that improvement of the present system is desired, but just what form this will take is not yet clear. An attempt is also being made to develop a system of temper designations for both aluminum and magnesium alloys.

Electrodeposited Metallic Coatings

Committee B-8 has completed its exploratory exposure tests of copper-nickel-chromium coatings on steel and is working on a comprehensive exposure test program for such coatings. The tests of electrodeposited lead coatings on steel still continue.

The subcommittee on conformance tests has recently organized three working sections: on thickness tests; on porosity tests; and on adhesion, hardness and ductility tests and a fourth section on luster tests is being organized. These sections are working very closely with the project-directing subcommittees of the American Electroplater's Society Research Committee.

A recommended practice on the preparation of high-carbon steel for electroplating has been drafted and will soon be completed and a similar recommended practice for zinc-base alloy die castings is to be prepared. A program of tests of supplementary protective coatings, especially for zinc and cadmium, is being developed.

Metal Powders and Metal Powder Products

The glossary of 131 powder metallurgy terms on which Committee B-9 has been working for some time is now ready for final committee ballot. The committee will review its present standards and methods of test, as well as future ones, to see that the terminology used in the glossary is properly followed.

Study still continues on the development of a test bar. Work done indicates there may be a need for two types of tension test bars, one to be tested as pressed and sintered and the other to be tested after machining.

The committee is working closely with Committee E-3 in the development of methods of chemical analysis of metal powders. Other active studies include methods of particle size determination and development of a test for the compressibility of metal powders. Work is also under way on test methods for transverse rupture, hardness, chemical composition, and microstructure of cemented carbides. The desirability of a classification and designation system for the various grades of commercially produced carbides is also under consideration.

Filler Metal

Since the Annual Meeting, the Joint A.S.T.M.-A.W.S. Committee on Filler

Metal has organized its new subcommittee on capillary brazing materials. This committee will assume jurisdiction of the specifications for brazing solder (B 64) and silver solder (B 73). The subcommittee plans to incorporate both of these specifications, with the addition of new alloys and requirements for phos-copper alloys, in a single new specification.

Plans are under way to divide the present Specifications for Iron and Steel Arc-Welding Electrodes (A.S.T.M. A 233-A.W.S. A 5.1) into three parts. A revised Specification for Iron and Steel Gas-Welding Rods (A 251) is being prepared and a new Specification for Aluminum Alloy Gas-Welding Rods is nearing completion. Specifications for Aluminum Alloy Arc-Welding Electrodes will be next on the program and draft Specifications for Nickel and and Nickel-Alloy Filler Metal are in preparation. Work on copper and copper-alloy filler metal and on surfacing materials is also being actively followed.

Another important activity of the Joint Committee is the work on the Classification Designation of Filler Metal. Two ways of approaching the problem have been suggested—one with the designating number giving information regarding the characteristics of the filler metal and the other a purely arbitrary system.

Metallography

Several new projects will occupy the attention of Committee E-4 during the current year. Drafts of methods for the determination of preferred orientation in worked metals and for the determination of crystal orientation by the back reflection method are currently being completed.

Cooperation with the American Society for X-Ray and Electron Diffraction continues and, through these efforts, improved data cards and indexing will soon be available to users of the Hanawalt Method (E 43).

The subcommittee on grain size is now working on ferrite grain size, magnesium grain size and aluminum grain size and reviewing the old non-ferrous grain size chart in E 2.

Fatigue

Real progress is being made by Committee E-9 in its work on preparing a Manual on Fatigue Testing. First drafts of a majority of the sections of the Manual had been reviewed in February (March Bulletin, p. 40) and revisions of these were again reviewed at the Annual Meeting, as well as first drafts of two new sections, those on Testing Machines and Testing Techniques. The Research Subcommittee of Committee E-9 is following closely the important current research projects on fatigue.

The "C" and some "D" and "E" Groups

Cement

Considerable attention has been given by Committee C-1 to the specification requirements for portland cement. These studies have led to certain recommendations affecting the specifications for portland cement (C 150) and air-entraining portland cement (C 175) noted elsewhere in this issue (see Annual Meeting article). Studies are being continued on the inclusion of Types III, IV, and V cements under the specification for air-entraining portland cement and on the adequacy of the air-entrainment limits. Investigations designed to secure data that would assure writing a durability specification for mortar cement is being continued, which includes autoclave tests, freezing and thawing tests and determination of air content and absorption of mortar. The use of the air permeability fineness test in place of the No. 325 sieve test is being considered as a requirement in the Tentative Specifications for Portland Blast-Furnace Slag Cement (C 205 T). A problem receiving an increasing amount of attention by Committee C-1 in cooperation with Committee C-9 on Concrete and Concrete Aggregates is the chemical reactivity of aggregates in concrete and an acceptance test is under development. Other current standardization projects cover test methods on bleeding, strength tests of portland cement, the acceptability of materials used as additions to portland cement, optimum SO_3 content for a given cement, and investigation of the details of the apparatus and procedures involved in determining the air content of standard mortars.

Clay Pipe

Committee C-4 on Clay Pipe renewed its activity by approving for submission to letter ballot a new tentative specification for standard strength perforated clay pipe. This tentative corresponds in all respects to the present A.S.T.M. specification for standard strength clay sewer pipe (C 13 T) except for perforations, and corresponds with the Commercial Standards now in preparation by the National Bureau of Standards. During the current year the committee will review and recommend any necessary revisions in the specifications covering standard strength clay sewer pipe (C 13 T) and extra strength clay pipe (C 200 T) for adoption as standard, and in the recommended practice for laying sewer pipe (C 12).

Lime

Although it was felt inadvisable during the current year to draft a master specification for the use of lime in the chemical industry, Committee C-7 on Lime will continue to study the matter during the next two or three years by collaborating with some of the outstanding engineers in each of the industries. Currently the committee will collaborate on a review and research of the existing specifications as well as consideration of the additional specifications for chemical lime used in other industries, but not now covered.

Refractories

In addition to numerous recommendations recently submitted by Committee C-8 on Refractories, active work is being carried out on several other standardization projects. The subject of creep of refractories is being studied in at least four laboratories with the report of one such investigation being already published by the National Bureau of Standards. The subject of load under high temperatures is being investigated by a canvass of leading universities in the U. S. and Canada to establish available research facilities to study the effect of the time of the schedule and a comparison of loads of 25 and 50 psi. Studies are being sponsored to learn of the effect of some variations in size of standard pyrometric cones on the end point as well as collection of data on PCE determinations as made in oxyacetylene, gas-air and electric furnaces. A procedure for the determination of thermal conductivity at high temperatures is being studied. The equipment for this process is reaching the point of perfection permitting accuracy of ± 1 per cent and requiring the total time of operation at not more than 7 or 8 hr.

Concrete and Concrete Aggregates

A proposed method of evaluation of air-entraining admixtures for concrete has been developed by Committee C-9 on Concrete and Concrete Aggregates for publication as information only. After any further revisions as a result of the preliminary publication of this method it will be submitted to the Society for acceptance. Two new test methods now under consideration cover a test for determination of bleeding of concrete and a method for determination of strength of bond of concrete to reinforcing steel (pull out test). There is continuing activity in the study of the formulation of a standard test method of durability of concrete and concrete aggregates.

Mortars

The subcommittee on research of Committee C-12 on Mortars for Unit Masonry has prepared a test method of analyzing fresh mortars which is being circulated among the committee members. This includes determinations on moisture, sand content, cement content, and lime, as well as compression tests. Investigations are continuing on methods of determining efflorescing tendencies of mortars.

Glass and Glass Products

Committee C-14 on Glass and Glass Products has recommended for adoption as standard the definition of the term "glass"

(C 162 T) and is now preparing a glossary of further terms used in the glass industry. A new standard sample of glass sand of low iron content is being prepared and will be issued by the National Bureau of Standards after analysis has been made in the laboratories of several of the committee members. Two series of comparative tests have been run, and a third is now arranged, primarily for the formulation of a method of testing durability of glass and glass containers. The committee is giving attention to proposed revisions of the Federal Specifications for Flat Glass (DD-G-451). A proposed method of test for sampling and testing structural nonload-bearing cellular glass blocks is being studied.

Manufactured Masonry Units

New projects being initiated by Committee C-15 include specifications for nonmetallic mineral flue lining and for chemical resisting brick. The revision of a proposed specification for facing brick and studies of proposed specification for facing tile continue.

Thermal Insulating Materials

Dimensional standards are receiving the attention of Committee C-16 in an endeavor to establish satisfactory tolerances and clearances of insulation. These values would be a guide in the production of these materials. A proposed method for determination of thermal conductivity, conductance, and transmittance of materials by the guarded hot box method is planned for final vote of the committee at its fall meeting. A method of test of thermal conductivity of pipe insulation is being studied. Two methods of test concerning moisture effects (on blanket and semirigid insulation) and methods for evaluating properties before and after exposure are in process. The determination of density of loose-fill insulation is still a problem. Other activities involve the measurement of thermal properties other than thermal conductivity and the committee is considering several methods of measuring specific heat.

Natural Building Stones

A list of definitions is under consideration by Committee C-18 which includes definitions of granite, limestone, dolomite, marble, and sandstone, among others. Initial activity has been inaugurated in the preparation of specifications. The physical properties of stone will be the base for these specifications. Progress has been made on preparation of specifications for roofing slate.

Road and Paving Materials

Two new specifications covering asphalt cement for use in pavement construction and for hot-mixed, hot-laid asphaltic concrete base and surface courses will be submitted during the year to the Administrative Committee on Standards by Committee D-4 on Road and Paving Materials. These two new tentatives will fill a long-standing need. In addition, a tentative revision of the standard method of test for distillation of cut-back asphaltic products (D 402) will be submitted for approval. This change will minimize foaming difficulties and at the same time obtain the same test results with the revised method as would be obtained by the standard method.

Coal and Coke

Committee D-5 has under way an active program of work as indicated in the accompanying brief summary.

The present analytical procedures for determining carbon, hydrogen, and nitrogen in coal given in the Standard Methods of Laboratory Analysis of Coal and Coke (D 271) are being revised by the subcommittee on methods of test. These revisions will improve the methods by making better use of equipment and chemicals now available and also will effect a saving of time in making these determinations.

Results of work done during the past year to get data on the suitability of the Brabender moisture oven for determination of moisture in coal will be prepared for publication by the U. S. Bureau of Mines. The Bureau is also cooperating with Committee D-5 by conducting experimental work to standardize a procedure for measuring slacking or weathering tendencies of coals. Standardization of such a test method is needed in connection with classifying coals by rank according to the Standard Specification for Classification of Coals by Rank (D 388).

The subcommittee on nomenclature and definitions is preparing definitions for "free moisture" and for "bound" or "inherent moisture" in coal. At present there is considerable confusion and misunderstanding as to the significance of the different forms of moisture in coal, so definitions are needed. This subcommittee also has under consideration definitions of the terms "coking" and "caking" as applied to coals in connection with coal carbonization and coal combustion.

Investigations of methods for determination of particle size of coal by means of resistance to air flow are being continued by the subcommittee on pulverizing characteristics of coal. Such methods are believed to be desirable, if satisfactory, as a substitute for the more laborious procedures of measuring size by the customary sieving methods.

The subcommittee on coal friability is to revise the present Tentative Method of Drop Shatter Test for Coal (D 440) as the application of the test to various coals has shown that misleading results may be obtained if 2 by 3-in. size coal as now specified in the method is used for testing the relative friability of different coals.

The subcommittee on coal sampling has collected and evaluated considerable data in regard to the number of increments and size of gross samples required for predetermined accuracies in the sampling of coal for the volatile matter determination in connection with city smoke ordinances. The subcommittee probably will prepare this coming year a sampling procedure for consideration as a tentative method.

Investigations of laboratory methods for determination of ignitibility of coal and coke are being continued. Much work has been done in the past but more needs to be done because of the inherent difficulties in developing a satisfactory test procedure. Earlier experimental work was described in the ASTM Bulletin, October, 1941, p. 23.

The subcommittee on significance of tests of coal and coke will begin the preparation of a series of papers covering the significance of the various tests sponsored by Committee D-5 in connection with uses of coal and coke for purposes as follows: (1) combustion, (2) carbonization, (3) complete gasification, (4) liquefaction, and (5) special uses. When completed, these papers will form the basis for a new A.S.T.M. publication "The Significance of Tests of Coal and Coke."

The subcommittee on designation of coal sizes has under development methods for screen sizing of small sizes of coal by means of mechanical methods in place of the hand screening methods as now given in the Standard Method of Test for Screen Analysis of Coal (D 410).

Studies of various methods for sampling and fineness testing of pulverized coal are being continued by another subcommittee. Considerable effort is being made to standardize a satisfactory method for sampling pulverized coal from a moving stream of coal as blown through pipes enroute from pulverizers to the furnaces. Collection of representative samples under these conditions is difficult and requires special equipment used under controlled procedures.

Paper and Paper Products

Committee D-6 has under consideration an imposing list of test methods concerning both physical and chemical properties of paper. Some of these will cover elongation, brightness, absorption resistance, stiffness, total chloride content and redistribution of sulfur and zinc pigments. Numerous revisions of standard and tentative methods now published are being studied which include the testing for basis weight of paper, water vapor permeability of paper and paperboard at normal and elevated temperatures, and humidity. Test procedures are being formulated for use with fiberboard and fiber containers covering such physical requirements as

bursting strength, adhesiveness of component parts, ring crushing and flat crushing. Two proposed test methods are being published as information only, pertaining to the siliceous grit content of paper and paper products and the scuff resistance of paperboard. These methods will be submitted to the Society after further review.

Wood

Among the activities of Committee D-7 on Wood is the formulation of a standard procedure for testing glued, laminated lumber for use in determining whether the product meets various types of requirements. Also it is hoped that during the next year agreement will be reached on the difficult problem of formulating general specifications for plywood. A draft of specifications for creosoted end-grain wood block flooring for interior use is undergoing further revision for submission as a tentative. The committee has realized the need for specifications for extensively used preservatives other than those now covered by A.S.T.M. and will devote time to this project. A new subcommittee has been organized and will initiate work on specifications and methods of tests for wood poles and for cross arms. Active work is in progress on a secondary standard for testing wood in the form of 1 by 1-in. specimens as a companion method to D 143. The need for the secondary standard has developed because of the increasing importance of the evaluation of the properties of the material from smaller trees, including second growth. Apparatus has been developed for a test method for determining the moisture content of wood treated with chemicals such as are used in fire-retardant treatments.

Water Proofing and Roofing Materials

Revisions will be considered by Committee D-8 to include the effect of the size of the sample upon the results in the test methods covering prepared roofing and shingles. The study of grading specifications and test methods for roofing granules is in process together with a cooperative program on the development of a paper stain test. Other standardization projects include formulation of specifications for cold-applied, built-up roofing materials, accelerated weathering tests and a glossary of terms.

Shipping Containers

Committee D-10 on Shipping Containers is continuing a study of a vibration test method and on test methods covering bags, sacks, and cylindrical containers. In addition to the method of test for water vapor permeability of shelf-size packages (D 895) accepted during the current year, the committee is drafting additional test methods covering water resistance of containers by the spray method and also by the submersion method, as well as a test method for water vapor permeability of shipping containers. Work has been started on the collection of data for performance standards and for interior packaging standards. A list of standard definitions of terms which has had several revisions is expected to be completed during the current year. This will fill an important need in this field.

Adhesives

An expansion of the present tension test methods (D 897 T) to include other materials than wood and metal is being studied by Committee D-14 on Adhesives. Test methods which will produce a more nearly pure shear measurement than those now in existence and a method for testing laminated assemblies for flexural strength are currently nearing completion. Data are being accumulated to form the basis of a test method on the effect of biological factors. Additional projects in process include a study of cleavage as differentiated from peel, methods for measuring flexure characteristics of adhesive films, and cure properties.

Soils for Engineering Purposes

Proposed revisions of the standard methods of surveying and sampling soils for highway subgrades (D 420) are under consideration in Committee D-18 on Soils for Engineering Purposes. These revisions include aerial photographic methods for making soil profiles. All available data on triaxial load testing are being assembled for standardization purposes. Other new projects include the development of specifications for backfill material for French drains and other roadway drainages, specifications for drainage properties in base courses, and a test method for measuring permeability of granular and semigranular materials. The joint subcommittee of Committees D-4 and D-18 will continue its activity on the standardization of various materials for stabilization—asphalt, tar, asphaltic emulsion, cement, and granular material.

Water for Industrial Uses

The preparation of the Manual on Industrial Waters remains the major item of unfinished business at this time on the schedule of Committee D-19. Topical outlines of each chapter have been prepared and are being submitted to the committee for approval.

A proposed method for sampling of steam is being drafted. New methods of test are being prepared for determination of acidity and alkalinity; of hardness; of alkali metals in water; for iron; for dissolved gases such as chlorine, chloramine and ammonia; and for nitrogenous substances (nitrates and nitrites). A test for determination of electrical conductivity of industrial waters is also being drafted and the study of the subject of the classification of water for industrial uses continues.

Fire Tests

Committee E-5 on Fire Tests of Materials and Construction is developing a method for gaging the combustible properties of wood treated with fire-retardant chemicals. The method of testing and classification of materials for acoustical and other interior finishes of buildings will be developed to augment the regular fire test specifications. Work on a proposed specification for fire tests of window assemblies has been suspended pending development of further information on the need for such a standard and the feasibility of framing suitable performance requirements. There is considerable confusion of thought on defining terms regarding fire resistance. The committee hopes to bring some order out of that confusion in the near future by standardization of the definitions of certain terms such as "fire resistive," "fire retardant" and "flame proof."

Building Constructions

It is expected that drafts of tentative methods will be completed during the current year by Committee E-6 on Methods of Testing Building Constructions, covering the testing of large structural units, including methods of testing roof trusses. Methods of testing specific types of building assemblies, including prefabricated roofing trusses, will be prepared for submission to the committee. Methods are being planned on some structural elements, probably centering around light steel joists. This will include the testing of rolled light steel joists, precast reinforced concrete floor and roof slabs, and assembled floor and roof slabs such as clay tile or concrete block and reinforced steel.

The Best Research Engineers

"The best research engineers I have known have been those whose minds are open to conviction and who are able to make their own decisions. Just because something is stated as a fact in the scientific literature is no positive proof that it is a truth. Formulae, equations, and rules were made to be challenged and exist only because someone challenged former rules."

A statement by Dr. H. C. Rentschler on his retirement after 30 years of service directing Westinghouse lamp and electronic tube research at Bloomfield, N. J.

Second International Conference on Soil Mechanics and Foundation Engineering

THE SECOND International Conference on Soil Mechanics and Foundation Engineering will be held in Rotterdam, Holland, in June, 1948. This meeting, sponsored by the Netherlands Government, is a resumption of the series initiated at Harvard University in 1936 and interrupted by the war. The president of the Conference is Karl Terzaghi, Consulting Engineer and Professor of Engineering Practice at Harvard University. The Conference is being organized by J. P. Van Bruggen, Director of Public Works, Rotterdam, T. K. Huizinga, Director of the Laboratory of Soil Mechanics in Delft, and other Dutch engineers. The Conference will be conducted in the English language.

In the United States, a National Committee on Soil Mechanics, consisting of outstanding foundation engineers and soil mechanics experts representing professional engineering and technical societies and governmental engineering organizations, has been formed. Philip C. Rutledge, Professor of Civil Engineering at Northwestern University, is chairman of the Committee. Its official address is: U. S. National Committee on Soil Mechanics, the Technological Institute, Northwestern University, Evanston, Illinois. To insure adequate representation of the United States in the technical works of the Conference, the National Committee has been divided into fifteen subcommittees covering the major technical subdivisions of Soil Mechanics and Foundation Engineering.

Prospective members of the Conference and authors of papers are requested to notify the National Committee of their intentions as soon as possible. To meet the conditions set up by the Dutch organizing committee, authors of papers to be published in the first volume of Proceedings of the Conference must submit in triplicate to the National Committee a title and brief (250-word description of each paper prior to September 1, 1947. For this volume completed papers must be received by the National Committee by December 1, 1947.

Organized travel for those attending the Conference is planned and will be arranged by the National Committee. Complete information on the Conference can be obtained by writing to the U. S. National Committee on Soil Mechanics.

A.S.T.M. through the work of its Committee D-18 on Soils for Engineering Purposes has done a great deal to advance the knowledge of properties of soils and has developed a number of methods of evaluating soils and has sponsored symposiums and technical discussions in this field. The Society has been invited to participate in the planning of this International Conference, and Professors E. J. Kilcawley, Chairman of Committee D-18, and W. S. Housel, Vice-Chairman, have been appointed to serve as A.S.T.M. representatives on the U. S. National Committee.

Tests of Instruments for the Determination, Indication, and Recording of the Specific Gravity of Gases

BY

FRANCIS A. SMITH, JOHN H. EISEMAN, AND E. CARROLL CREITZ

National Bureau of Standards Miscellaneous Publication M-177, Superintendent of Documents, United States Government Printing Office, Washington 25 D. C. January 20, 1947, 143 pp., 46 figures. Price $1.00.

THE SPECIFIC gravity is an important property of industrial gases. Recognizing the need for a careful appraisal of existing methods of measuring this property in the case of gaseous fuels, the National Bureau of Standards undertook a study of available instruments for the determination and recording of specific gravity of gases in cooperation with A.S.T.M. Committee D-3 on Gaseous Fuels. Eleven instruments were studied using 15 test gases of known specific gravity. The investigation was completed in 1941, but publication of the results was delayed because of the war.

This little volume will be of considerable value to anyone who is concerned not only with gaseous fuels but with other types of industrial gases as well. It represents a painstaking study of the different instruments and a careful consideration of the theoretical aspects of specific gravity determination. As an illustration of this, a correction for change in the dimensions of paper used in recording instruments is included, in addition to the usual corrections for water vapor and carbon dioxide content of reference air, and deviation from ideality. The discussions of the sources of error involved in the use of each instrument are sufficiently complete to enable the user to evaluate his own techniques and to determine the precautions that must be taken in order to arrive at the desired precision.

The test gases studied include helium, nitrogen, helium-nitrogen mixtures of four different compositions, carbon dioxide, hydrogen-carbon dioxide, three nitrogen-carbon dioxide mixtures, synthetic typical manufactured gas, synthetic typical natural gas, propane and normal butane. The specific gravity of the test gases varied from 0.1526 to 2.0644.

The authors wisely make no attempt at a comparative evaluation of the instruments but present the results of their studies in sufficient detail to enable one to decide for himself the instrument best adapted to his needs.

The report fills a gap in the scientific literature on the subject of specific gravity of gases.

A. W. GAUGER
Penn State College

40-Year Members

CONTINUING the policy of recognizing those members who have been affiliated with the Society for 40 years there were awarded to 14 companies and individuals at the Annual Meeting in Atlantic City certificates testifying to their four decades of continuous membership in the Society. Including those recognized this year, the total 40-year membership now has reached the 114 mark. The 1947 list follows:

Herbert Abraham
E. H. Beckstrand
Henry C. Boynton
Alexander J. Christie
Thomas R. Lawson
C. P. Marsh
Raymond G. Osborne
Reading Company
Rensselaer Polytechnic Institute
Harry A. Schwartz
John Fairfield Thompson
Percy H. Walker
Morton Owen Withey
Youngstown Sheet and Tube Co.

Matthews' Textile Fibers

Matthews' Textile Fibers, Fifth Edition, edited by Herbert R. Mauersberger, is a completely revised edition of this classic reference book on textile fibers. It contains recently discovered facts on textile fibers as well as data from the fourth edition of 1923 which have become accepted truths.

The topics covered by the Fifth Edition correspond generally to those in Dr. Matthews' last revision. The difference is in the increased coverage given to artificial fibers; the regenerated and acetate rayons and synthetic fibers, and in the elimination of topics on fabricated textiles not now pertinent or which are more germane to textile reference books on fabrics. The new edition contains an introduction relating the history of fibers and an excellent classification of fibers. The physical, chemical, and microscopical properties observed in fibers form a section of the book. Discussions of cellulose, cotton, wool and fur, and vegetable fibers, regenerated and acetate rayons, synthetic and mineral fibers are given. The sections on fibers cover production, statistical data, chemical, physical, and microscopical properties. Fiber identification, quantitative fiber analyses, and fiber testing methods are each discussed in separate sections.

The organization and preparation of the book differ from the last edition in two ways which are probably responsible for the excellence of the content. Each section was written by an expert in the field. The present great rate of increase of knowledge of textiles makes it impossible now for one person, as Dr. Matthews once did, to collate well all the known facts in all fields of textile fibers. The addition of detailed references at the end of each chapter is an excellent feature, particularly for the student and the research worker.

The discussion of fiber testing methods is somewhat disappointing in its lack of extensiveness. The properties of fibers, which form a considerable portion of the book, are obtained by the application of test methods; therefore, some mention of the testing techniques used in all fiber property discussions would be pertinent. Perhaps what is really needed is a book devoted solely to fiber testing methods. As it stands now, there is no one reference book that is complete in its coverage of this field.

Comparing the sections on vegetable fibers with those on wool, cotton, and synthetics shows the lack of data on physical, chemical, and microscopical properties that now exists in the former field. It is to be hoped that research will increase here.

The issuance of the Fifth Edition of *Matthews' Textile Fibers* makes portions at least, of other technical textile reference books, such as the *American Wool Handbook*, the *American Cotton Handbook*, and the *American Rayon Handbook*, out of date. It is to be hoped that when these are revised their content and that of *Matthews' Textile Fibers* will complement and reinforce one another rather than overlap.

In *Matthews' Textile Fibers* the textile industry has a reference book comparable in quality to such works as the *Mechanical Engineers' Handbook*, the *Chemical Engineers' Handbook*, and other well-known and respected technical reference books. The editor and collaborators deserve commendation for the splendid job they have done. The engineer in the textile and associated industries will find this a most helpful book.

The 1150-page publication can be procured from the publisher, John Wiley & Sons, 440 Fourth Ave., New York, N. Y., at $12.50 per copy.

O. P. Beckwith

Radiography in Modern Industry

One might expect that a publication issued by the Eastman Kodak Co. would appeal to the eye, and further that the publication would be authoritative. These conditions are certainly met in this new publication just issued by the X-ray Division of the company. The book is not the work of one author but many have cooperated, including the personnel of the Kodak Research Laboratories and the Industrial X-ray Division, plus suggestions from field representatives and suggestions from manufacturers of X-ray equipment.

Following a discussion of the function of radiography in industry, which is stated "to assure satisfactory performance and lower costs," there is a discussion of the process, the X-ray generating apparatus required, with successive chapters covering geometric principles involved, factors governing exposure, screens, and the important problem of scattered radiation.

Other chapters relate to the arithmetic of exposure, sensitivity and detail visibility, and special techniques. The Kodak films are described, methods of processing, and there is an interesting discussion with diagrams of the processing room, in order that the films can be handled quickly there with the best quality result. An important part of the book is a rather detailed discussion of the density of industrial X-ray films, and the important matter of protection for personnel is covered. There is an outline of causes and remedies for unsatisfactory radiographs. A bibliography is given in which there are numerous references to A.S.T.M. publications and papers, including the 1936 Symposium on Radiography and X-ray Diffraction Methods, and the 1943 Symposium on Radiography. The book is complete with a detailed index.

It is pointed out that while new uses of industrial radiography are being reported constantly, some of them rather spectacular, basically the reason for its economic usefulness is the fact that it provides a permanent, visible film record of the internal structure of an object without damaging it in any way. The future possibilities of radiography and much of the progress that has been made are due in no small measure to the radiographer, and to this fraternity the book is directed.

This book is also outstanding from the physical appearance. Excellent coated paper is used, many of the large number of illustrations, charts, and diagrams are printed in black on a yellow background, which adds to the detail and aids readability, and the whole is issued in a substantial binding. Comprising 130 pages, 8½ by 11 in., the publication can be obtained from the Eastman Kodak Co., Rochester, N. Y., or through Kodak X-ray dealers, at $3 per copy.

Standards for Filter Papers

Standards of quality for analytical filter papers, previously nonexistent for this important item in chemical research and analysis, are being developed by the Paper Laboratory of the National Bureau of Standards through a critical evaluation of all currently available brands. Based on improved testing methods, together with established procedure for certain basic determinations, it is believed the standards will provide a ready means of determining the suitability of a particular paper for its intended use. Requirements will be included for the three classes of general analytical work involving coarse, medium, and fine precipitates.

Analytical filter papers, like many other laboratory materials, have an importance to science and industry far in excess of their dollar value. Many industrial processes require quick, accurate analysis for their control and these depend, in many cases, on the speed, retentiveness, and purity of the filter paper used in making the analyses.

Filter papers have been used and bought by brand names, practically as a tradition among laboratory workers, and many have been imported papers, most of which have come from England, Germany, and Sweden. When the war made supplies from these sources uncertain, American manufacturers began production of grades of analytical papers that had not previously been made in this country. In order to provide data that would be useful as a

guide to manufacturers and users in comparing the quality of different papers, as well as to eliminate dependence on brand names, the Bureau undertook an investigation of the physical and chemical properties of the papers.

Improved methods were developed for determination of rate of flow of water through the papers, retention of fine precipitates, and ash contents, as well as a method for measuring the bursting strength of wet paper. Density, purity of cellulose, and acidity, for which definite testing procedures were already available, are also important determinations.

The method for rate of flow of water is of special interest and it simulates the manner in which filtrations are made. The filter paper is folded in a cone in the usual way, taking care to expel air pockets. Instead of placing in a funnel, however, the cone is suspended freely in a wire loop, thus eliminating the variables such as design, angle, and stem dimensions of the funnel. It was found necessary to prefilter the water used in the test, but when this was done, highly reproducible results were obtained.

It was found that some papers not only became brittle with age, but that decomposition products were formed that might contaminate the solutions being filtered. An accelerated aging test previously developed for paper generally enabled a satisfactory prediction of stability to be made.

This work has shown significant differences among filter papers which, if studied critically, may point the way to future improvements. For example, some papers of equal retentiveness differ in speed, and hence may yield a clue as to how still faster papers may be made.

Patents Available for Licensing

THE patents noted below have been assigned to the Secretary of the Interior and are available for licensing. It has been customary to issue these licenses on a nonexclusive, royalty-free basis. Those who wish to make application for licenses should write to the Solicitor, Department of the Interior, Washington 25, D. C. Copies of the patents may be obtained from the Patent Office at 25 cents per copy. The first of the following patents was issued in 1938 and the last one on February 11, 1947.

Patent No.	Title
2,118,829	Preparation of Cobalt-Copper Catalysts
2,119,560	Electrolytic Process for the Extraction of Metallic Manganese
2,180,354	Water Surveying Apparatus
2,185,224	Purification of Rock Minerals
2,215,484	Sonic Flocculators and Method of Flocculating Smoke or the Like
2,255,069	Method and Apparatus for Separating and Concentrating Gases
2,283,954	Apparatus for Testing the Embrittlement Cracking Characteristics of Solutions
2,283,955	Means for and Methods of Testing Embrittlement Cracking Characteristics of Solutions
2,288,610	Treatment of Ores
2,297,538	Liquid Oxygen Explosive
2,297,670	Method of Protecting Boilers and the Like Against Embrittlement
2,297,689	Separation of Feldspar from Quartz
2,317,413	Process for the Concentration of Boron Chemically Combined from Its Ores by Autoflotation
2,353,193	Recovery of Metallic Magnesium
2,362,500	Apparatus for Testing Flame Safety Lamps
2,364,088	Core Drilling
2,366,184	Production of Potable Water from Saline Solutions
2,371,629	Artificial Thermals
2,374,674	Method for Thermal Decomposition of Metallic Nitrates
2,380,406	Production of Low Sulphur Sponge Iron
2,383,467	Flotation of Iron Ores
2,385,819	Beneficiation of Beryllium Ores
2,395,475	Beneficiation of Beryllium Ores
2,395,902	Electronic Chronoscope for Measuring Rates of Detonation
2,403,481	Method of Concentrating Iron Ore
2,407,651	Concentrating Fluorspar by Froth Flotation
2,410,043	Process for Manufacturing Calcium Fluoride
2,411,157	Means for Collecting Gas Analysis Samples
2,412,217	Froth Flotation of Chromite with Fluoride
2,414,118	Synthesis of Fluorene and Its Derivatives
2,414,815	Beneficiation of Beryllium Ores
2,415,416	Froth Flotation of Si from Fe Ore with Anionic Collector

Spectrographic Standards

ADVICE has been received from Johnson, Matthey & Co., Ltd., London, England, that they are not in a position to supply standard steels as noted in the "Report on Standard Samples for Spectrographic Analysis" recently published by A.S.T.M. While this company has undertaken the production of certain spectrographically standardized substances they advise that at the present time their products do not include steels.

To the A.S.T.M. Committee on Membership, 1916 Race St., Philadelphia 3, Pa.

Gentlemen:

Please send information on membership to the company or individual indicated below.

_____

_____

This company (or individual) is interested in the following subjects: *(indicate field of activity, that is, petroleum, steel, non-ferrous, etc., etc.)*

_____

*(Signed)*_____

Date_____ Address_____

Standard Testing Atmosphere Proposed for Federal Specifications

EDITOR'S NOTE.—The following proposal of the Technical Committee of the Federal Specifications Board has been received by the Society for comment and to request cooperation in reaching agreement on standard laboratory atmospheric conditions for procurement testing. This subject is of considerable interest to a number of A.S.T.M. committees and the action of the F.S.B. committee will be brought to their attention for consideration. During the past two years the standardization of temperature and humidity conditions for testing has been the primary interest of Technical Committee X of Committee E-1 and Robert Burns, as chairman of this Committee on Conditioning and Weathering, has directed the A.S.T.M. effort for standardization in which much progress has been made.

THE Federal Specifications Technical Committee on Standard Temperature and Relative Humidity Conditions at its meeting on July 2 adopted the following resolution:

Resolved, that this Committee recommends that the following standard laboratory atmospheric conditions be adopted for procurement testing under Federal Specifications: 73.5 F. (23 C.), with a tolerance of ±2 F. (1.1 C.) unless otherwise specified, and 50 per cent relative humidity, with a tolerance of ±2 per cent unless otherwise specified; that a conversion period of one year be allowed during which all committees and agencies concerned shall (1) review existing material specifications in order to effect any necessary revisions of property requirements, and (2) establish property requirements for all new materials and specifications under the proposed conditions; and that at the end of the conversion period the stated testing conditions shall be standard for all Federal Specifications except where special conditions are required as, for example, (1) in the prediction of material or product performance under unusual service temperatures and humidities, (2) in tests involving organisms, seed germination, and similar biological problems, and (3) in tests of timepieces, tools, gages, and other precision measuring instruments involving an international agreement.

The proposed standard laboratory atmospheric conditions are meant to be used whenever temperature or humidity or both must be controlled in order to obtain reproducible test results.

This proposal has now been sent to the Executive Vice-Chairman of the Federal Specifications Board for circulation to the Government agencies for comment in accordance with standard procedure for obtaining approval of Federal Specifications. The Federal Committee emphasizes that the proposed temperature and relative humidity conditions have been selected on the basis of personnel comfort and efficiency for general testing work, based on a comfort chart for conditioned rooms prepared by the American Society of Heating and Ventilating Engineers The specific conditions of manufacture or use of a material or product or the scientific precedent or technical background of any particular temperature or relative humidity have not been permitted to lead to any sacrifice with respect to providing an environment in which the personnel can work comfortably and hence efficiently the year round.

The lack of standardization of laboratory atmospheric conditions for general testing work has made it necessary for individual Government laboratories to maintain rooms at many different conditions of temperature and relative humidity in order to meet the requirements of present Federal Specifications. This represents a needless additional expense for installation and upkeep as well as considerable inconvenience during a period of breakdown and repair of equipment.

Furthermore, many types of products now being purchased represent combinations of materials for which present conditioning requirements differ. For example, a resin-coated fabric is composed of a textile which is tested at 70 F. and 50 per cent relative humidity. This situation is getting steadily more complex and confusing.

Industrial Carbon

MUCH useful information on the various forms of industrial carbon is provided in the second (1946) edition of the book by C. L. Mantell entitled "Industrial Carbon." A wide range of specialized technologic applications, covering most of the industrial uses of carbon other

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To the A.S.T.M. Committee on Membership

1916 Race St., Philadelphia 3, Pa.

Gentlemen:

Please send me information on membership in A.S.TM. and include a membership application blank

*(Signed)*_____

Address_____

Date_____

than as a fuel, are treated under the following main and chapter headings:

Elemental Forms: Introduction, Diamonds, Natural Graphite, Carbon Black, Lampblack, Acetylene Black, Pigments.

Adsorbents: Bone Black, Vegetable Decolorizing Carbon, Gas Adsorbents, Other Adsorbent Chars.

Manufactures: Historical Aspects of Manufactured Carbon, Artificial Graphite, Raw Materials for Carbon Manufactures, Preparatory Processes, Electrodes, Brushes, Arc Light and Illuminating Carbons, Carbon Specialties and Resistors, Carbon as a Material of Construction, Porous Carbon, Electronic Tube Anodes, Refractories.

Analyses and Properties: Analytical and Testing Methods, Physical and Chemical Properties.

This book presents information on the above topics, with the aid of 169 line drawings and photographs, 52 numbered tables, a large number of other tabulations of physical and chemical properties, many references to other publications, with an index at the end of the book to these references by names of the author, and a detailed subject index.

This publication, clearly printed on good paper in a durable binding, is available from D. Van Nostrand Co., Inc., 250 Fourth Avenue, New York, N. Y., at $7.50 per copy.

Death of Izod

IT HAS just come to our attention through the pages of *Journal of the Institute of Metals*, that Mr. E. G. Izod, the originator of the well-known impact test which bears his name, died in England on October 2, 1946, at the age of 70 years.

Although his name was so widely known among engineers and metallurgists throughout the world, Mr. Izod himself was not so generally recognized by them as the author of the Izod impact test, partly, no doubt, because he pronounced his name "Izzod," whereas the practice has developed of referring to the test as the "I-zod," but partly also because he regarded its discovery as merely one early incident in a long and active life and admitted candidly that he had done comparatively little to extend its application and interpret its wider significance.

It was while he was assistant to Captain H. Riall Sankey at the works of Willans and Robinson at Rugby that Izod discovered almost by chance the significance of impact on the physical strength of metals. Sankey had been asked to examine a burst shotgun barrel for possible defects in the steel and deputed Izod to test the metal against that of a sound barrel. The two steels appeared to be precisely similar. At last he had the idea to put small notched test specimens in a vice and hit them with a hammer. Under repeated blows, one merely bent over, but the other snapped off short at the first blow. He did little himself to develop a technique of impact testing beyond circularizing a few friends about his "discovery"—which they ignored—and, with promotion to higher office (eventually he became Assistant Managing Director) he was fully occupied with other work. He went to Africa and remained there for 17 years, retiring in 1927 when he was Managing Director of the Rand Mines, a position he held for 9 years. Subsequently, however, he became Managing Director of the Weymann Motor Bodies, Ltd., in which position he was active throughout the war and until a short time before his death.

Microcalorimetry

THIS book, by W. Swietoslawski, Professor in absentia of Physical Chemistry of the Institute of Technology, Warsaw, and Senior Fellow, Mellon Institute, Pittsburgh, Pa., is said to be the first publication devoted exclusively to the subject of microcalorimetry, which is a technique of constantly widening application. Microcalorimetric measurements recently have been employed in physics, physical chemistry, physiology, biology, metallurgy, the cement industry, and other industrial research. This 210-page publication presents a detailed coverage of the theory and methods of microcalorimetry and of the apparatus used therein. Fifty-six figures aid in a clear presentation of the material, particularly in the case of the descriptions of apparatus. A list of 130 literature references is included to make the coverage of the subject more complete. The book has both an author index and a subject index. This book, clearly printed on good paper, is available at $4.75 per copy from the Reinhold Publishing Corp., 330 W 42nd St., New York, N. Y.

Calibration Fuels Established for CFR Octane Method

THERE have been recently published by the Society two tables giving calibration for blends of benzene, *iso*-octane, and normal-heptane. The information given covers the micrometer setting for standard knock intensity at various pressures, for various mixtures of the two fuels, A and B, and their respective octane numbers. Fuel A is a blend of 50 per cent benzene and 50 per cent *n*-heptane, while fuel B is a blend of 50 per cent benzene and 50 per cent *iso*-octane. Copies of these two-page tables in letter size can be procured from A.S.T.M. Headquarters at 25 cents each or in accordance with the following scale:

One copy	25 cents each
Two to four	20 cents each
Five to nine	15 cents each
Ten and over	10 cents each

Printer Dedicates Building Extension

IF, AT some distant date, access is made to the cornerstone recently laid for the Mack Printing Co. in connection with dedication of their building extension, among the material found will be a copy of the ASTM BULLETIN, along with copies of a number of other journals and society sponsored publications issued by the Mack Printing Co. The extension of the present printing facilities, including building, new presses, etc., was necessitated by a very heavy printing and publishing load, in large measure due to the tremendous increase in publications of the American Chemical Society, but also those of a number of other professional and technical groups. Our own ASTM BULLETIN, for example, while a small portion of the total volume issued by the company, has grown greatly in the last five years.

Sieves Which Pass the Wheat

"BUT from the beginning our chief purpose has been the direct and immediate service of mankind. We have always been a going business concern. We saw that a great work lay ready at our hands, that not only of facilitating trade but of protecting the less well informed buyer from the necessarily better maker, and conversely by protecting the self-respecting manufacturer from the competition of the unscrupulous, ever too ready to prey on the ignorance or cupidity of the buyer. This we set out to do by using the expert knowledge of our members for the purpose of making standard specifications—standards of justice and reasonableness—to which all could appeal from the demands of the unreasonable and unscrupulous. We have created sieves which pass the wheat but stop the chaff. The wonderful growth of the Society and the great devotion of its members to its often arduous work are due in very large part to the importance of this our service to the public, and to our great leader, Dr. Dudley, to whose lofty character were added all the essentials of leadership in such an undertaking . . . . in a word, the highest idealism, perfect familiarity with the subject, and the most astute practical wisdom."

—From the 1912 A.S.T.M. Annual Address by President Henry M. Howe.

New Members to July 5, 1947

The following 134 members were elected from April 19 to July 5, 1947, making the total membership 6348.

Names are arranged alphabetically—company members first, then individuals.

Chicago District

U. S. Reduction Co., Marvin L. Kaufmann, Vice-President, Box 30, East Chicago, Ind.

Brady, H. P., Sales and Service Engineer, W. H. Barber Co. 3650 S. Homan Ave., Chicago 32, Ill.

Duvall, W. A., General Manager of Maintenance, The Greyhound Corp., 2600 Board of Trade Bldg., Chicago 4, Ill.

Grossweiner, Leonard I., Research Assistant, Argonne National Laboratory, Box 5207, Chicago 80, Ill. For mail: 5419 Drexel Blvd , Chicago 15, Ill. [J]*

Haase, Harold F., Associate Professor of Chemical and Metallurgical Engineering, Marquette University, 1515 W. Wisconsin Ave., Milwaukee, Wis. For mail: 2919 W. Juneau Ave., Milwaukee 8, Wis.

Holtz, Henry G., Chief Metallurgist, Taylor Forge and Pipe Works, 4735 W. Fourteenth St., Chicago 50, Ill.

Platte, Maurice M., Engineer, Hotpoint, Inc., 5660 W. Taylor St., Chicago, Ill. For mail: 2906 N. Mildred Ave., Apt. 2P, Chicago 14, Ill. [J]

Sherman, Milton, Chief Chemist, Silverstein & Pinsof, 1720 Elston Ave., Chicago 22, Ill.

Siegel, Harold H., Metallurgist, Howard Foundry, 4920 Bloomingdale Ave., Chicago, Ill. For mail: 4820 N. Kedzie Ave., Chicago 25, Ill.

Cleveland District

Ferro Enamel Corp. Library, M. Bozsin, 4150 E. Fifty-sixth St., Cleveland 5, Ohio.

Rodgers, William, Assistant Chief Metallurgist, Republic Steel Corp., Republic Bldg., Cleveland 1, Ohio.

Ryks, Everett W., Paint Technician, The Arco Co., Cleveland 4, Ohio.

Detroit District

DeVilbiss Co., The, D. J. Peeps, Chief Engineer, 300 Phillips Ave., Toledo 1, Ohio.

Glenvale Products Corp., Januarius A. Mullen, President, 1165 Beaufait St., Detroit 7, Mich.

Campbell, Byron F., Chief of Laboratories, Harry Ferguson, Inc., 15020 Woodward Ave., "H" Bldg., Detroit 3, Mich.

Edgar, William J., Assistant Director of Laboratories, Federal-Mogul Corp., 11031 Shoemaker, Detroit 13, Mich.

McMullan, O. W., Chief Metallurgist, Bower Roller Bearing Co., 3040 Hart Ave., Detroit 14, Mich.

New England District

Boston Elevated Railway, John A. Canton, Chief Engineer, 31 St. James Ave., Boston 16, Mass.

High Voltage Engineering Corp., E. Alfred Burrill, Application Engineer, 7 University Rd., Cambridge 38, Mass.

Burstein, Sol, Engineer, Stone & Webster Engineering Corp., 49 Federal St., Boston, Mass. For mail: 198 Chester Ave., Chelsea 50, Mass. [J]

Clarke, Eugene S., Metallurgist, United Shoe Machinery Corp., Research Div., Balch St., Beverly, Mass.

Whelan, John E., Laboratory Supervisor, City of Boston, 105 Dorchester Ave., South Boston 27, Mass.

New York District

American Thread Co., The, Curtis E. Bowne, General Manager, Industrial Sales Div., 260 W. Broadway, New York 13, N. Y.

Lummus Co., The, E. F. Tibbetts, Metallurgist, 420 Lexington Ave., New York 17, N. Y.

Pantasote Co., The, Edward Hazlehurst, Technical Director, 26 Jefferson St., Passaic, N. J.

Standard Chemical Products, Inc., Arthur H. Kramer, Chief Chemist, 1301 Jefferson St., Hoboken, N. J.

Tile Council of America, 10 E. Fortieth St., New York 16, N. Y.

Bassett, Walden E., Textile Technician, Celanese Corporation of America, 180 Madison Ave., New York, N. Y.

Benson, Stanley E., Chief Engineer, Great American Industries, Inc., Connecticut Telephone and Electric Div., 70 Britannia St., Meriden, Conn.

Carlin, Frank J., Jr., Development Chemist, U. S. Rubber Co., General Labs., Passaic, N. J. For mail: R.F.D. #2, Allendale, N. J.

Cohan, L. H., Director, Technical Service Lab., Witco Chemical Co., 719 First Ave., New York 17, N. Y.

Collura, Vincent R., Secretary-Treasurer, Public Service Testing Laboratories, Inc., 381 Fourth Ave., New York 16, N. Y.

DiMartino, Michael, Technical Director, Public Service Testing Laboratories, Inc., 381 Fourth Ave., New York 16, N. Y.

Doede, Clinton M., Vice-President and Secretary, The Connecticut Hard Rubber Co., 407 East St., New Haven 11, Conn.

Fowler, Fred C., Engineer, 377 S. Orange Ave., W., South Orange, N. J.

Friedlin, Thomas H., Timber Engineer, New York Central System, 466 Lexington Ave., New York 17, N. Y.

Gilman, Lucius, Chief, Plastics Laboratory, Picatinny Arsenal, Dover, N. J. For mail: Box 65, Lake Hopatcong, N. J.

Goldin, Sidney, Manager, Asphalt Dept., Shell Oil Co., Inc., 50 W. Fiftieth St., New York 20, N. Y.

Happe, W., Jr., Federal Telephone and Radio Corp., 100 Kingsland Rd., Clifton, N. J.

Hoffman, Alfred W., Laboratory Manager, Container Laboratories, Inc., 45 E. Twenty-second St., New York 10, N. Y.

Merkle, George E., Vice-President and General Manager, Fiske Brothers Refining Co., 129 Lockwood St., Newark 5, N. J.

Murlless, Malcolm, Metallurgist, Monroe Calculating Machine Co., Orange, N. J.

Paige, Henry, Chemical Development Engineer, Arma Corp., 254 Thirty-sixth St., Brooklyn, N. Y. For mail: 576 E. Ninety-first St., Brooklyn 12, N. Y. [J]

Pike, Charles Olson, Research Director, Bishop Gutta-Percha Co., 420 E. Twenty-fifth St., New York 10, N. Y.

Pritchard, L. R., Chief Chemist, Lone Star Cement Corp., 342 Madison Ave., New York 17, N. Y.

Quade, Maurice N., Chief Engineer, Structural and Highway Div., Parsons, Brinckerhoff, Hogan & MacDonald, 142 Maiden Lane, New York 7, N. Y.

Sargent, Robert E., Manager, Sales Service, Rayon Div., Celanese Corporation of America, 180 Madison Ave., New York 16, N. Y.

Smith, Charles L., Metallurgist, The Miller Co., 99 Center St., Meriden, Conn.

Stacy, Eliot R., Chemist, American Cyanamid Co., Calco Chemical Div., Pigment Dept., 158 Mt. Olivert Ave., Newark 5, N. J.

Tomasetti, M. C., Civil Engineer, Construction Materials Testing Service, 163 Weyman Ave., New Rochelle, N. Y.

Ward, Robert E., Chief Metallurgist, Eclipse-Pioneer Division of Bendix Aviation Corp., Teterboro, N. J.

Weber, Joseph, Assistant Superintendent, The Paraffine Cos., Inc., 205 W. Main St., Somerville, N. J.

Woodson, W. S., Jr., Chemical Engineer, The Manhattan Shirt Co., Box 1410, Paterson, N. J.

Northern California District

Oronite Chemical Co., J. J. Morrisroe, Manager, Technical Service, 200 Bush St., San Francisco 4, Calif.

Dickinson, Thorn, Resident Engineer, Stone & Webster Engineering Corp., Box 929, San Francisco 1, Calif.

Kline, Bertram F., Chief Chemist, Southern Pacific Co., General Shops, Test Dept., Sacramento 14, Calif.

Staples, W. R., West Coast Sales Manager, The Carpenter Steel Co., Kenilworth, N. J. For mail: 24 California St., San Francisco 11, Calif.

Philadelphia District

Day & Zimmermann, Inc., Thomas W. Hooper, Engineering Manager, Packard Bldg., Philadelphia 2, Pa.

Electric Hose and Rubber Co., Paul Hopkins, Technical Manager, Twelfth and Dure Sts., Wilmington 99, Del.

Lehigh Spinning Co., Thomas F. Jacoby, Director of Chemical Research, 229 S. Carlisle St., Allentown, Pa.

Scott Paper Co., D. Fronmuller, Mill Research Engineer, Chester, Pa.

Twitchell, Inc., E. W., Lloyd Carpenter, Technical Representative, Third and Somerset Sts., Philadelphia 31, Pa.

Barth, Frederic H., Proprietor, Industrial Rubber Co., 101–103 E. Lehigh Ave., Philadelphia 25, Pa.

Felgendreger, Alfred F., Chief Chemist, Continental Mills, Inc., Armat and Lena Sts., Philadelphia 44, Pa.

Furlow, John W., Partner, Eggly-Furlow, 1500 Walnut St., Philadelphia 2, Pa.

Magoun, J. W., Chief Metallurgist, Modjeski & Masters, State St. Bldg., Harrisburg, Pa.

Olyphant, Murray, Jr., Research Assistant, Princeton University, Plastics Laboratory, 30 Charlton St., Princeton, N. J. [J]

Peterson, Clifford E., Chief Chemist, Riegel Paper Corp., Riegelsville, N. J.

Preisendanz, Edward S., Junior Designer-Draftsman, United Engineers and Constructors, Inc., 1401 Arch St., Philadelphia, Pa. For mail: 142 W. Hillcrest Ave., Havertown, Pa. [J]

Proctor, Kenneth L., Supervising Chemist, Industrial Test Laboratory, U. S. Naval Shipyard, Philadelphia, Pa. For mail: 117 Whitman Ave., Collingswood, N. J.

Winchell, Clarence W., Supervisor, State of New Jersey, Bureau of Standardization and Testing, State House, Trenton 7, N. J. For mail: 297 Euclid Ave., Hackensack, N. J.

Pittsburgh District

Koppers Co., Inc., Engineering and Construction Division, Paul J. Homan, Chief Development Engineer, 648 Koppers Bldg., Pittsburgh 19, Pa.

Hodge, Willard Wellington, Senior Fellow, Mellon Institute of Industrial Research, 4400 Fifth Ave., Pittsburgh 13, Pa.

Kessler, Monroe H., Strip Steel Metallurgist, Weirton Steel Co., Weirton, W. Va.

Mickley, William H., Chief Inspector, The National Supply Co., Spang-Chalfant Division, Bridge St., Etna 23, Pa.

St. Louis District

Nu-Pro Manufacturing Co., Thomas M. Langan, Secretary-Treasurer, Box 422, St. Louis 3, Mo.

Southern California District

Grimm, Bruce F., Chief of Design, G. M. Giannini Co., Inc., 285 W. Colorado, Pasadena, Calif.

Stuckey, Arthur R., Resident Engineer, Stone & Webster Engineering Corp., 49 Federal St., Boston 7, Mass. For mail: Box 264, Bakersfield, Calif.

Western New York and Ontario District

Fedders-Quigan Corp., Robert W. Morgan, Chief Engineer, 57 Tonawanda St., Buffalo 7, N. Y.

Alman, Lawrence C., Industrial Engineer, Industrial Engineering Dept., Eastman Kodak Co., Kodak Park Works, Rochester 4, N. Y.

U. S. and Possessions

AMERICAN SEATING Co., H. S. Leader. Research Engineer, 901 Broadway, Grand Rapids, Mich.

ARCHER-DANIELS-MIDLAND Co., S. O. Sorensen, Technical Director, 600 Roanoke Bldg., Minneapolis 2, Minn.

ATLANTIC STEEL Co., C. J. Blackmon, Box 1714, Atlanta 1, Ga.

DUNCAN ELECTRIC MANUFACTURING Co., R. A. Road, Chief Engineer, 244 S. Third St., Lafayette, Ind.

HENDRICK MANUFACTURING Co., D. McM. Blackburn, Plant Manager, Drawer 497, Carbondale, Pa.

INTERNATIONAL BUSINESS MACHINES CORP., W. A. Stadtler, Metallurgist, Poughkeepsie, N. Y.

NATIONAL CLAY PIPE MANUFACTURERS, INC., Fred S. Cresswell, Manager, 600 Rupley Bldg., 815 King St., Alexandria, Va.

WESTERN AUTO SUPPLY Co., L. B. Lingham, Manager of Merchandise Research, 2107 Grand Ave., Kansas City 8, Mo.

ALLQUIST, JOHN W., Superintendent of Technical Control, Celanese Corporation of America, Rome, Ga. For mail: 100 Chatillon Rd., Rome, Ga.

BHATE, K. G., Executive Engineer, Designs Division, Government of Bombay, India. For mail: The Embassy of India, 2107 Massachusetts Ave., N. W., Washington, D. C.

COLORADO AGRICULTURAL AND MECHANICAL COLLEGE, J. G. Hodgson, Librarian, Fort Collins, Colo.

GOODING, R. M., Petroleum Chemist, U. S. Bureau of Mines, Washington 25, D. C.

HAWTHORNE, J. G., Vice-President, Kansas City Testing Laboratory, 700 Baltimore, Kansas City 6, Mo.

IRELAND, FRANK, Technical Director, Brown & Bigelow, St. Paul 5, Minn.

JOHNSON, CLEMENT OLE, Superintendent, Fuel and Water Service, Seaboard Air Line Railroad Co., Jacksonville, Fla. For mail: 306 W. Bay St., Jacksonville 2, Fla.

KEITH, JOHN W., Chief Chemist, The Texas Company, Port Neches, Tex. For mail: Box 1537, Port Neches, Tex.

KING, OLIVER F., Chief Engineer, Parkersburg Rig and Reel Co., Box 7357, Houston 8, Tex.

LAMB, JOHN J., Physicist, National Bureau of Standards, Washington 25, D. C.

MAKEMSON, ROBERT W., Testing Engineer, Box 628, Jacksonville 1, Fla.

MOBLEY, WILLARD M., Chief Chemist, Alabama By-Products Corp., Tarrant 7, Ala.

MUELLER, EUGENE F., Physicist (Retired), 3914 Huntington St., N. W., Washington 15, D. C.

PETERSON, C. A., Manager, The National Refining Co., Findlay, Ohio.

RIEGEL, G. C., Chief Metallurgist, Caterpillar Tractor Co., Peoria 8, Ill.

ROBIN, RALPH, Engineer (General), P4, Office of the Housing Expediter, Technical Services Branch, Tempo E Bldg., 4th and Adams Dr., S. W., Washington, D. C. For mail: 1514 Seventeenth St., N. W., Washington, D. C.

SIMMONS, WARD F., Metallurgist, Battelle Memorial Inst., 505 King Ave., Columbus 1, Ohio.

SITZLER, RICHARD R., Research Supervisor, Celanese Corporation of America, Cumberland, Md.

SULLIVAN, H. D., Manager, Central Pre-Mix Concrete Co., 805 N. Division St., Spokane 11, Wash.

TOMES, LEWIS A., Research Associate, National Bureau of Standards, Connecticut Ave. and Van Ness St., N. W., Washington, D. C. For mail: 5111 Forty-first St., N. W., Washington 16, D. C.

UNIVERSITY OF SOUTH CAROLINA, SCHOOL OF ENGINEERING, R. L. Sumwalt, Dean, Columbia, S. C.

VAIL, KENYON C., Manager, Laboratories, Inc., 811 Larimer St., Denver 4, Colo.

WEIKEL, STEWART F., Member of Firm, Sandlass, Wieman & Associates, 1021 N. Calvert St., Baltimore 2, Md.

WELBORN, J. YORKE, Associate Highway Engineer, Public Roads Administration, Division of Physical Research, Washington 25, D. C.

Other than U. S. Possessions

BOUND BROOK BEARINGS (G. B.) LTD., B. P. R. Parsons, Managing Director, Birch Rd., Witton, Birmingham 6, England.

CIA. MEXICANA DE CEMENTO PORTLAND "APASCO" S. A., F. Gómez Segovia, Assistant Manager, Balderas 31, Desp. 402, México D. F., Mexico.

COMPAGNIE ALAIS, FROGES & CAMERGUE, Frejacques, Chef Du Service Central De Recherches, 23 Rue de Balzac, Paris, France.

DALMIA CEMENT, LTD., N. C. Roy, General Manager, Scindia House, New Delhi, India.

REICHHOLD CHEMICALS, INC., J. M. Hatrick, Director, 68 Mentmore Ave., Rosebery, Sydney, Australia.

TRINIDAD LEASEHOLDS, LTD., Technical Library, Pointe-a-Piere, Trinidad, B. W. I.

AYUELA, AURELIO, Director, Artillery Division, Army General, Claudio Coello 38, Madrid, Spain.

BAKER, E. GORDON, Metallurgical Dept., The Steel Co. of Canada, Ltd., Hamilton, Ont., Canada.

BLONDIAU, LÉON, Directeur de la S. A. Des Ciments De Thieu, 51 Rue Docteur Coffér, Bracqueqnies, Belgium.

FINNISH STATE INSTITUTE FOR TECHNICAL RESEARCH, E. Wegelius, Director General, Lönnrotink 37, Helsinki, Finland.

FISHER, ARTHUR, Research Engineer, Vickers-Armstrongs, Ltd., Barrow-in-Furness, England. For mail: 81 Booth Rd., Waterfoot, Rossendale, Lancs., England.

HICKETHIER, CARLOS F., Chemist, Azucnaga 1183, Buenos Aires, R. 22, Argentina.

INSTITUTE OF TECHNOLOGY, DEPARTMENT OF METALLOGRAPHY, Vojtech Jareš, Professor, 13 Karlovo nám. Prague, Czechoslovakia.

JOHANSON, STIG BÖRJE HENNING, Civil Engineer, Mo och Domsjö AB, Örnsköldsvik, Sweden.

KNOUSE, SAMUEL B., JR., Water Supply Engineer, Pacific Islands Engineers, Ferry Bldg., San Francisco, Calif. For mail: Station 10, Guam, Guam.

LAGERQVIST, JOEL, Director, Chemical Laboratory, Sieverts Kabelverk, Sundbyberg, Sweden.

MACRIS, COSTAS G., Analyst and Consulting Chemist, Socrates Street No. 22, Athens, Greece.

MANN, IAN DARNEY, Engineer, Continental Can Co. of Canada, Ltd., 55 Cote De Liesse Rd., St. Laurent, Quebec, P. Q., Canada. [J]

NATIONAL RESOURCES COMMISSION, METAL MINING ADMINISTRATION, Nanking, China.

PLATOU, EILIF, State Inspector of Explosives, Drammensveien 130, Sköyen, Norway.

RAGHAVACHARY, K. S., Consulting Engineer, Government of India, Transport Dept., New Delhi, India.

SCHWARZKOPF, F., Chief Chemist, La Cemento Nacional C. A., Box 103, Guavaquil, Ecuador.

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* [J] denotes Junior Member.

Personals . . .

. . . News items concerning the activities of our members will be welcomed for inclusion in this column.

ROBERT LINDLEY ZIEGFELD, formerly Assistant Secretary, Lead Industries Association, has been elected Acting Secretary and Treasurer. K. C. Brownell, Executive Vice-President of American Smelting and Refining Co., has been elected Vice-President, member of the Executive Committee and Board of Directors of the same association.

PAUL VAN CLEEF, Vice-President of Van Cleef Bros. Co., chemical manufacturers, and President of the Greater Chicago Safety Committee, has been elected to fill a vacancy on the Chicago School Board. Mr. Van Cleef is a longtime active Past member serving on Committee D-11 on Rubber and Rubber-Like Materials since 1924; he is also a member of Committee D-14 on Adhesives and of the Chicago District Council.

JOHN J. GREBE, Director of the Physical Research Laboratory of Dow Chemical Co., Midland, Mich., has been awarded the Hyatt gold medal and $1000 in recognition of his contribution to the development of styrene.

RALPH C. SWANN has been appointed Director of the Research Department of the Bon Ami Co., New York. He was formerly with the American Mineral Spirits Co. and the Pure Oil Co.

WILLIAM A. MUDGE has been appointed Director of the Technical Service Section of the Development and Research Division of The International Nickel Co., succeeding O. B. J. FRASER, who recently was made Assistant Manager of the Development and Research Division. Dr. Mudge has been with International Nickel since 1920. He is representative for his company on A.S.T.M. Committee B-4 on Electrical Heating, Resistance, and Related Alloys.

P. E. CAVANAGH, formerly Metallurgist, Allen B. Du Mont Laboratories Inc., Passaic, N. J., and who was associated with the Ontario Research Foundation, has become President of Cyclograph Services Ltd., in Toronto, Canada.

R. D. T. HOLLOWELL, for 20 years Secretary-Manager, Non-Ferrous Ingot Metal Institute, retired and was succeeded April 1 by Isadore Glueck. Prior to 1945, Mr. Glueck was associated with Federated Metals Division, American Smelting and Refining Co.

WILLIAM H. BASSETT, JR., is now Commanding Officer, Ordnance Department Alabama Ordnance Works, Sylacauga, Ala.

ARTHUR HEWITT of the Warner Co., Philadelphia, has been elected President of the Central Pennsylvania chapter of the Pennsylvania Society of Professional Engineers.

Past-President JOHN R. TOWNSEND, Materials Engineer, Bell Telephone Laboratories Murray Hill, N. J., and Past-Director SAM TOUR, President, Sam Tour & Co., Inc., New York, also NORMAN L. MOCHEL, Chairman of Committee A-1 on Steel, and Manager, Metallurgical-Engineering, Westinghouse Electric Corp., Philadelphia, are among the seven judges who will appraise entries and select winners of the 1947 *Materials & Methods* Achievement Awards. These Achievement Awards, presented for the first time in 1946, were established by *Materials & Methods* to honor those doing outstanding current work in the development, application, and processing of engineering materials. The 1947 Awards are to be made specifically "for the most significant use of modern engineering materials and processing methods to increase production and reduce

the cost of products now being manufactured." The winners will be announced in October.

HARRY A. SCHWARTZ, Manager of Research, National Malleable and Steel Castings Co., Cleveland, has been awarded an honorary membership in the Belgium Foundrymen's Association. The only other scientist to receive this honor is the well-known French metallurgist, Albert Portevin. Mr. Schwartz is a long-time active A.S.T.M. member, receiving his 40-year certificate of continuous membership at the recent annual meeting in Atlantic City. He was formerly Chairman of the Cleveland District, and has been representative of the American Foundrymen's Association since 1928 on Committee A-7 on Malleable-Iron Castings, of which committee he was secretary for many years.

R. H. PATCH, Vice-President in charge of Operations, E. F. Houghton and Co., Philadelphia, Pa., has announced the appointment of Dr. H. B. Walker as Research Supervisor in charge of Development of Textile Chemicals and Leather Finishes.

ROBERT D. JUVE, of Goodyear Tire and Rubber Co., Akron, Ohio, has been appointed synthetic rubber coordinator, and his duties will involve the coordination of research, development, production, and end-use activities of the various synthetic rubbers.

S. S. SHAFFER has been named Head of the Experimental and Testing Division of the Laboratory of the Humble Refining Co., at Baytown, Texas. He was formerly Chief Chemist. As head of this newly formed unit, Mr. Shaffer will have charge of work centering in control testing for the refinery and other company departments, and experimental service, as well as research on projects of immediate importance.

CLIFFORD F. RASSWEILER, Vice-President for Research and Development of the Johns-Manville Corp., was chosen recently as chairman of the New York section of the American Chemical Society.

CARL B. SMITH has retired, after many years' service as Engineer of Tests of the Billerica Shops of the Boston & Maine Railroad. Mr. Smith was representative of the Railroad's A.S.T.M. membership for 20 years, and also was a long-time active member of Committee A-1 on Steel.

FRANCIS E. BASH has been elected Assistant Vice-President of Driver-Harris Co., Harrison, N. J. He was formerly Manager of the Technical Dept. Mr. Bash, who represents Driver-Harris Co. in A.S.T.M., has been Secretary of Committee B-4 on Electrical Heating, Resistance, and Related alloys since 1929, also has rendered important service on other committees.

STANTON WALKER was elected to serve as President of the American Concrete Institute until the 1948 convention of the organization. His election was announced at the 43rd annual convention held recently in Cincinnati. Mr. Walker has been a member of the Institute since 1921, a member of the Board of Directors since 1940, and has served as Vice-President for the last two years. He is well known as Director of Engineering of the National Sand and Gravel Assn. and of the National Ready Mixed Concrete Assn. He is a long-time A.S.T.M. member, and active committee worker, having served as Secretary of Committee C-9 on Concrete for many years.

HARRISON F. GONNERMAN, the retiring A.C.I. President, who is Director of Research, Portland Cement Assn., is also an active A.S.T.M. committee member, as are the incoming Vice-Presidents, ROBERT F. BLANKS (of the U. S. Bureau of Reclamation, Denver) and HERBERT J. GILKEY (of Iowa State College, Ames). Four Regional District Directors likewise are active in A.S.T.M. committee work, namely: WILLIAM H. KLEIN, Easton, Pa.; H. P. BIGLER, Consultant, Rail Steel Bar Assn. CHARLES H. SCHOLER, Kansas State College of Agriculture, Road Materials Laboratory; and HARRY F. THOMSON, Vice-President, General Material Co., St. Louis, Mo.

OLIVER BOWLES, Chief of the Nonmetal Economics Division of the U. S. Bureau of Mines, Washington, D. C., retired early this year, after thirty-three years of Government service. Dr. Bowles, long-time Chairman of A.S.T.M. Committee C-18 on Natural Building Stones, plans to devote his time to writing, consulting work, and to his hobby of flower culture.

JOHN H. LONGBOTTOM is now practicing as Consulting Chemist, in Norwood, Pa.

JOHN H. HRUSKA, formerly Director of Metallurgy, Tests and Inspection, Electro-Motive Div. of General Motors Corp., La Grange, Ill., is now Consulting Engineer specializing in Metallurgy and Welding, Hinsdale, Ill.

MAX SCHUSTER is now Director of Quality Control and Development, Cantor-Greenspan Co., Inc., New York, N. Y. He was formerly associated with Macy and Co.

GEORGE B. WATERHOUSE is now Professor *Emeritus*, Department of Metallurgy, Massachusetts Institute of Technology. He is located in Belmont, Mass., as Consulting Engineer and Metallurgist. A member of A.S.T.M. since 1922, Prof. Waterhouse has rendered valuable service on several technical committees.

JOSEPH A. KIES, formerly with the Western Regional Research Lab., U. S. Dept. of Agriculture, Albany, Calif., is now Senior Metallurgist, Clinton Laboratories, Monsanto Chemical Co., Oak Ridge, Tenn.

HAROLD N. MYERS is now Staff Engineer, Perfect Circle Corp., Hagerstown, Ind. He was previously associated with the Sealed Power Corp., Muskegon, Mich., as Chief Metallurgist.

HERBERT C. HALLER, formerly Chief Chemist, Continental Mills, Inc., Philadelphia, Pa., is now Assistant Research Director, Forstmann Woolen Co., Passaic, N. J.

RAY C. GIDDINGS is now Chief Engineer, Transit Mixed Concrete Co., Pasadena, Calif. He was formerly associated with the Western Concrete and Equipment Co., Los Angeles.

JEAN R. WILLIAMS, formerly Chief Engineer, Markey Machinery Co., Inc., Seattle, Wash., is now Senior Engineer, Hanford Engineer Works, General Electric Co., Richland, Wash.

ISMOND E. KNAPP is now Technical Director, Southern Naval Stores Co., Chicago, Ill. He was formerly Chief, U. S. Department of Agriculture, New Orleans, La.

OTTO BRILL, formerly Chief Chemist of Laboratory, M. Hochschild y Cia. Ltda., Arequipa, Peru, has returned to U.S.A., and is now located in New York City.

C. L. DALZELL is now Project Engineer, General Foods Corp., New York, N. Y. He was previously with Bendler & Dalzell, of the same city.

R. C. SWANN, formerly Director of Research, American Mineral Spirits Co., New York, N. Y., is now Director of Research, Bon Ami Corp., New York.

ROGERS B. FINCH is now Assistant Professor of Textile Technology, Massachusetts Institute of Technology, Cambridge, Mass.

JOHN H. HRUSKA, until recently Director of Tests and Inspection for Electro-Motive Division of General Motors Corp. at La Grange, Ill., has resigned. He is now serving several industries as Consulting Engineer, specializing in metallurgical and welding problems. His office and laboratory are in Hinsdale, Ill., at 8400 County Line Road.

G. L. OLIENSIS, Director of Research, Lloyd A. Fry Roofing Co., has moved from St. Louis into the Chicago area, where a new laboratory has been built by the company. Mr. Oliensis, formerly Chairman of the A.S.T.M. St. Louis District, has been succeeded in that office by Professor A. W. BRUST of Washington University. The company address in Chicago is 5818 Archer Road, Summit, Ill. (Argo Ill., Post Office).

MYRON PARK DAVIS Chairman of the A.S.T.M. New York District Council, Chief Chemist and Metallurgist, Otis Elevator Co., has been elected a Director of the Technical Societies Council of New York, Inc. Mr. Davis was formerly secretary of this affiliated group, and has also served as secretary after the council was officially organized. H. C. R. CARLSON, Chief Engineer, Charles Fischer Spring Co., and O. B. J. FRASER, Director of Technical Service on Mill Products, The International Nickel Co., are also directors.

E. C. WRIGHT, formerly affiliated with the National Tube Co., and for some time Assistant to President, following service as Chief Metallurgist of the company, has resigned and has been appointed Head of the Department of Metallurgy in the University of Alabama where for many years he was on the faculty.

WENDELL F. HESS, holder of four national prizes for productive research in Metallurgy, has been appointed head of the Department of Metallurgical Engineering at Rensselaer Polytechnic Institute, Troy, N. Y. Dr. Hess, who has headed R.P.I's, Welding Laboratory since 1938, succeeds Dr. Matthew A. Hunter, who continues as Dean of the Faculty.

A. L. BRASSELL, who has been very active in the work of A.S.T.M., particularly in Committee D-13 on Textile Materials, has succeeded Dr. D. E. Douty as President of the United States Testing Co., Inc. Hoboken, N. J. Dr. Douty, a former officer of A.S.T.M., also has a long record of active service in the Society. He will continue his interests in the company as Chairman of the Board and Chairman of its Executive Committee. Many of the company's staff cooperate in various A.S.T.M. technical committees.

T. F. OLT recently was appointed Director of Research, American Rolling Mill Co., Middletown, Ohio. He succeeds Dr. Anson Hayes, who has been appointed Director Emeritus and will continue to be active with respect to research policies in ARMCO. Mr. Olt joined ARMCO in 1928 as a Metallurgical Assistant at the East Works plant, and served successively as Metallurgist, Senior Metallurgist, Senior Research Engineer, and Supervising Metallurgist; in 1940 he was further advanced to Associate Director of Research, and in 1945 became Assistant Director. In his present capacity as Director of Research he will assume representation of ARMCO membership in A.S.T.M., this representation having been carried by the retiring Director for the past 15 years.

FRANK E. LOBAUGH has been appointed Technical Service Director of the Lumnite Division, Universal Atlas Cement Co., a United States Steel Corp. subsidiary.

GEORGE BEISER, formerly engaged in work in the U. S. Department of Commerce, and also associated with the Bell Aircraft Corp., Buffalo, N. Y., as Process Engineer, has now opened offices as Engineering Consultant, 13 West Perry St., Buffalo 7, N. Y.

CHARLES E. WUERPEL, in government service for many years, most recently as Engineer-in-Charge, U. S. Waterways Experiment Station, Clinton, Miss., is now associated with the Inter-American Construction Corp., Buenos Aires, Argentina.

LEONARD ARTHUR TOONE, formerly Refinery Manager, Anglo-Egyptian Oilfields, Ltd., Cairo, Egypt, is now Refinery Manager, Cia de Petroleo Shell de Colombia, Colombia, S. A.

J. J. YATES has retired after many years of active service with the Central Railroad Co. of New Jersey.

HOWARD AGNEW SMITH, formerly Metallurgical Engineer, Beech Aircraft Corp., Wichita, Kans., is now Research Chemist, Fansteel Metallurgical Corp., North Chicago, Ill.

JOHN DE NAVARRE MACOMB has retired after many years' active connection with the Inland Steel Co., Chicago. A long-time active A.S.T.M. member, Mr. Macomb is present Vice-Chairman of the Chicago District Council.

SAM TOUR & CO., INC. and its affiliate, the American Standards Testing Bureau, Inc., both of 44 Trinity Place, New York City, recently announced the appointment of Col. Leslie S. Fletcher as Technical Director. Col. Fletcher, retired from the U. S. Army for Physical Disability, after completion of twenty-three years of commissioned service, formerly served on several A.S.T.M. technical committees while stationed at the Frankford Arsenal, Philadelphia.

ANANDA CHANDRA PADHI, formerly a Graduate Student, University of California, Berkeley, is now doing graduate work at the Massachusetts Institute of Technology.

MARTIN LANGSAM is now affiliated with Ebasco Services, Inc., New York City, as Estimating Engineer. He was formerly Chemical Engineer with the Drico Industrial Corp. of the same city.

GEORGE KEINATH, formerly Consulting Engineer, Great American Industries, Inc., Meriden, Conn., has opened his own office as Consulting Engineer, in Larchmont, N. Y.

G. ELLIOTT ROBINSON has been appointed Lecturer in Mechanical Engineering, Northeastern University, Boston, Mass. He was previously Test Engineer, Massachusetts Institute of Technology.

VIRGIL C. BARTLETT, formerly with the Ideal Cement Co., Denver, is now Chief Chemist, Union Portland Cement Co., Devil's Slide, Utah.

HARLAN A. DEPEW, long-time member and active in technical committee work is now Chemical Engineer, American Zinc, Lead and Smelting Co., Mountain Lakes, N. J. He was formerly associated with The Flintkote Co., Morristown, N. J.

C. H. EDWARDS, formerly Chief Chemist, Seaboard Air Line Railway, Jacksonville, Fla., has been appointed Assistant in Research at the Engineering and Industrial Experiment Station, University of Florida, Gainesville.

KENNETH B. ANDRUS is now Technical Service Representative, Kimble Glass Division of Owens-Illinois Glass Co., Chicago. He was formerly with Coleman Instruments, Inc., Maywood, Ill.

PAUL Q. HEWES, formerly at the University of Alabama, is now Chemical Engineer, National Southern Products Co., Tuscaloosa, Ala.

E. H. VAN WAGNEN is now Boxing Engineer, General Motors Overseas Operations, Detroit, Mich. He was formerly Senior Engineer, U. S. Forest Products Lab., Madison, Wis.

KENNETH A. SMITH, formerly Instructor of X-ray, Physics Dept., University of Southern California, Los Angeles, is now Consultant and Development Director, Primary Processes, Ltd., Los Angeles.

NECROLOGY

ROBERT G. N. EVANS, President and General Manager, Evans Engineering Co., Milwaukee, Wis. (December 18, 1946). Member since 1943. Represented American Society of Mechanical Engineers on A.S.A. Sectional Committee on Petroleum Products and Lubricants.

J. S. SAWYER, Manager, Railroad Sales Dept., Shell Oil Co., Inc., New York City (April 6, 1947). Member since 1937.

STEWART MARTIN, Chief Engineer, Standard Steel Spring Co., Newton Falls, Ohio (February 1, 1947). Member since 1946.

WILLIAM E. DALTON, Vice-President and Sales Manager, Will Corp., Rochester, N. Y. (May 30, 1947). A personal member since 1936 and beginning in 1942 the representative of his company membership. Mr. Dalton represented the Will Corp. on Committee D-13 on Textile Materials. His death was due to drowning. A graduate of Cornell University, he had been with his company for 28 years. He was also president of the Buffalo Apparatus Co., and Vice-President of the Southern Scientific Co.

F. A. KARTAK, Dean, College of Engineering, Marquette University, Milwaukee, Wis. (May, 1947). Represented the University membership since 1928.

SAMUEL B. BOWEN, JR., President, Pecora Paint Co., Philadelphia, Pa. (June 23, 1947). Mr. Bowen had been representative of the Pecora Paint Co. membership since 1935.

FRANK A. BARBOUR, Consulting Hydraulic and Sanitary Engineer, Boston (May 24, 1947). A long-time member of the Society, membership dating from 1898, Mr. Barbour served on the Executive Committee (now Board of Directors) from 1933 to 1935. An outstanding authority in his field of hydraulics and sewage disposal work, he was Past President of the American Waterworks Association and active in many other engineering groups. He was keenly interested in the work of A.S.T.M., and among other groups was serving on the A.S.T.M. New England District Council at the time of his decease.

T. R. AGG, Dean of Engineering, College of Engineering, Iowa State College, Ames, Iowa (May 7, 1947). An outstanding leader in the field of engineering education, Dr. Agg had been interested in A.S.T.M. activities for a great many years, his membership dating from 1914. He was particularly concerned with the work of Technical Committees C-4 on Clay Pipe and C-13 on Concrete Pipe, serving as Vice-Chairman of the latter since 1936.

For a number of years on the Staff of the University of Illinois faculty, he had been at Iowa State College since 1913, where he was Dean of Engineering beginning in 1932. He was active in the work of many technical and professional societies and groups. On June 13, 1947, he received posthumously the Marston Medal award, highest honor of the Division of Engineering of the Iowa State College, Dean Emeritus Anson Marston accepting the award for Dr. Agg.

LOUIS W. KEMPF, Assistant Director of Research, Aluminum Research Laboratories, Aluminum Company of America, Cleveland (June 14, 1947). Member since 1935. Very active in the work of numerous technical and professional soci-

eties, Mr. Kempf was an outstanding authority in his field. A former Chairman of the A.I.M.E. Institute of Metals Division, he had served in numerous other capacities in this group. He had been for a number of years Manager of the Cleveland Branch of the Research Laboratories.

ROY R. ZIPPRODT, Research and Consulting Engineer, Committee on Reinforced Concrete Research, American Iron and Steel Institute, and member of several A.S.T.M. technical committees including A-1 on Steel (June 20, 1947). Mr. Zipprodt had long experience in concrete research and design; he was a member of a number of technical groups and had directed important work involving concrete and reinforcement steel.

BENJAMIN LEWIS MCCARTHY, Assistant General Superintendent, Wickwire Spencer Steel Division of The Colorado Fuel and Iron Corp., Buffalo, N. Y. (June 28, 1947). Representative of Wickwire membership since 1937. Widely known in A.S.T.M. and in the Wire Association, "Mac" as he was known to his large number of friends and associates, passed away after a long illness. He had been largely responsible for the establishment of the Western New York-Ontario District centering in the Buffalo-Rochester-Toronto area, and was chairman of that group for a number of years. He had had two very serious operations just over a year ago but at the time of the Buffalo A.S.T.M. Annual Meeting had recovered sufficiently to attend that meeting and greet a number of his friends. He suffered a relapse early this year and was in the hospital several weeks prior to his death. An outstanding authority in the field of wire and wire products, he was honored by selection as Mordica Memorial Lecturer by the Wire Association. He served on A.S.T.M. Committees A-1 on Steel, A-5 on Corrosion of Iron and Steel, and A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys. While most of his work with Wickwire was along metallurgical and related technical lines, for some time he had been Assistant General Superintendent of the Buffalo plant.

John J. Harman Dies

A MEMORIAL Resolution has been received from the Manufacturers Standardization Society of the Valve and Fittings Industry on the death of John J. Harman, for many years General Secretary of the M.S.S. Following service with the National Tube Co. and for many years with the Walworth Co., he became M.S.S. Secretary in 1932, serving until his retirement in August, 1946.

Society Appointments

Several A.S.T.M. members have been reappointed and newly appointed as members of Society Administrative Committees as follows:

* R. D. BONNEY, Congoleum Nairn, Inc., and D. E. PARSONS, National Bureau of Standards, on the Administrative Committee on Standards.

* J. C. GENIESSE, The Atlantic Refining Co., L. A. MELSHEIMER, American Cyanamid Co., and C. H. SAMPLE, International Nickel Co., on the Papers and Publications Committee.

* JULES LABARTHE, Mellon Institute of Industrial Research, and *H. H. MORGAN, Robert W. Hunt Co., on the Ultimate Consumer Goods Committee.

* E. L. HOLLADY, Army Service Forces, *R. E. Peterson, Westinghouse Electric Corp., and L. B. Jones, The Pennsylvania Railroad Co. on the Simulated Service Testing Committee.

* T. P. DRESSER, Abbot A. Hanks, Inc., and *F. G. Steinebach, *The Foundry*, on the District Activities Committee.

P. D. BROSSMAN, *E. I. du Pont de Nemours & Co. (to fill the unexpired term of the late R. J. Moore) on the Research Committee.

H. J. GOUGH, Lever Brothers & Unilever, Ltd., England, to represent the Society at the Centenary Celebration of the Institution of Mechanical Engineers, held in England during the week of June 8.

H. F. MOORE, University of Illinois, as the Society's, delegate at the installation of George Dinsmore Stoddard as President of the University of Illinois, on May 16.

The following appointments have been made to committees of the American Standards Association:

D. W. KESSLER, National Bureau of Standards, on new Sectional Committee A91 on Specifications for Building Granite.

HENRY WYSOR, Bethlehem Steel Co., on Sectional Committee B17 on Standardization of Shafting, and on Sectional Committee B41 on Standardization of Stock Sizes, Shapes and Lengths for Hot and Cold-Finished Bars, succeeding J. J. SHUMAN.

L. S. REID, Metropolitan Life Insurance Co., on Subcommittee on Office Papers of New Sectional Committee X2 on Office Standards.

W. P. PUTNAM, The Detroit Testing Laboratory, on Sectional Committee A21 on Specifications for Cast Iron Pipe, succeeding J. D. STODDARD, deceased.

* Reappointments; all others new appointments.

Catalogs and Literature Received

JARRELL-ASH CO., 165 Newbury St., Boston 16, Mass. New Catalog No. I-3 entitled "Spectrographic Equipment" describes the Jaco research stigmatic grating spectrographs, a new inexpensive Jaco Jr. 3 Meter Spectrograph, an improved projection comparator microdensitometer, and miscellaneous spectrographic accessories. 20 pages. Illustrated. 8½ by 11 in. page size.

E. H. SARGENT & Co., 155–165 E. Superior St., Chicago 11, Ill. A 40-page catalog "Laboratory Apparatus and Equipment" includes photographs and descriptions of various types of equipment and laboratory supplies—balance rests, proteinometer, titration pipette, counting apparatus, hygrometers, etc.

THE GAERTNER SCIENTIFIC CORP., 1201 Wrightwood Ave., Chicago 14, Ill. Bulletin 158-74, "Wavelength Spectrometers and Monochromators" describes and illustrates six prism instruments, three for the visible region, two with quartz optics for the ultraviolet, and one with rock salt optics for the infrared. Several types of thermopiles and interference spectroscopes often used with the instruments are also listed. Twelve pages, 8½ by 11 in.

Also, Bulletin 157-74, "Divided Circle Spectrometers and Accessories" describes and illustrates six models capable of angular measurements to various accuracies from one minute to one second, polarizing attachments, light sources, prisms, and other items frequently used with this type of spectrometer. 20 pages, 8½ by 11 in. The factors to be considered in selecting a spectrometer are discussed and a number of industrial and educational applications are indicated.

THE EMIL GREINER CO., 161 Sixth Ave., New York 13, N. Y. A four-page folder, "Precise Fractionation Assembly" illustrating and describing this apparatus, listing its features, etc.

Calendar of Society Meetings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS—Fall Meeting, September 1–4, Salt Lake City, Utah.

INSTRUMENT SOCIETY OF AMERICA—September 8–12, Chicago, Ill.

NATIONAL INSTITUTE OF GOVERNMENTAL PURCHASING—Second Annual Conference, September 15–17, Hotel Pennsylvania, New York, N. Y.

ILLUMINATING ENGINEERING SOCIETY—Annual Convention, September 15–19, New Orleans, La.

ASSOCIATION OF IRON AND STEEL ENGINEERS—Fall Meeting, September 22–25, Pittsburgh, Pa.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—Middle Eastern District Meeting, September 23–25, Dayton, Ohio.

AMERICAN GAS ASSN.—September 29–October 3, San Francisco, Calif.

NATIONAL SAFETY CONGRESS AND EXPOSITION—October 6–10, Chicago, Ill.

ELECTROCHEMICAL SOCIETY—National Convention, October 15–18, Copley Plaza Hotel, Boston, Mass.

NATIONAL LUBRICATING GREASE INSTITUTE—50th Annual Convention, October 16–18, Edgewater Beac otel, Chicago, Ill.

NATIONAL METAL CONGRESS—October 20–24, Chicago, Ill.

AMERICAN WELDING SOCIETY—Annual Meeting, October 20–24, Chicago, Ill.

AMERICAN CHEMICAL SOCIETY—Pacific Chemical Exposition, October 21–25, Civic Auditorium, San Francisco, Calif.

PACIFIC CHEMICAL EXPOSITION—October 21–28, San Francisco, Calif.

NATIONAL ELECTRICAL MANUFACTURERS ASSN.—October 27–31, Atlantic City, N. J.

AMERICAN SOCIETY OF TOOL ENGINEERS—Semi-Annual Meeting, October 30–November 1, Boston, Mass.

X-RAY AND ELECTRON DIFFRACTION—Annual Conference, November 7–8, Mellon Institute of Industrial Research, Pittsburgh, Pa.

FEDERATION OF PAINT AND VARNISH PRODUCTION CLUBS—November 7–10, Ambassador Hotel, Atlantic City, N. J.

PAINT INDUSTRY SHOW—November 7–14, Ambassador Hotel, Atlantic City, N. J.

NATIONAL PAINT, VARNISH AND LACQUER ASSN.—November 11–14, Ambassador Hotel, Atlantic City, N. J.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, Midwest General Meeting, November 3–7, Chicago, Ill.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA—Eighth Annual Water Conference, November 12–14, Hotel William Penn, Pittsburgh, Pa.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS—Annual Meeting, December 1–5, Chalfonte-Haddon Hall, Atlantic City, N.J.

SCIENTIFIC APPARATUS MAKERS OF AMERICA—December 5–6, Hotel New Yorker, New York, N. Y.

S.A.E. Annual Meeting—January 12-16, Detroit, Mich.

AMERICAN FOUNDRYMEN'S ASSN.—Annual Meeting, Convention and Exhibit, May 3–7, 1948, Convention Hall, Philadelphia, Pa.

Our Stake in Materials Progress

Annual Address by the President

Arthur W. Carpenter[1]

June 18, 1947

IN CELEBRATING, this week, the Fiftieth Annual Meeting of our Society, it is fitting that we should pause a moment and consider the origin of our great organization, some of its outstanding accomplishments in promoting knowledge of the properties and methods of test of materials and its future prospect so far as we may be privileged to see. Perhaps, then, we can appraise our stake in materials progress. The dictionary tells us that a stake is "an interest; something to be gained or lost." I am sure we should all agree that our many years of growth and productivity amply demonstrate the magnitude and worth of our interest in the field of materials. So far, the scale is tipped strongly on the side of gain. The only uncertainty in the appraisal is that of the extent to which we shall in the future increase that stake, and avoid the loss which must surely follow if we fail in any way to live up to our responsibilities. The satisfactory resolution of this uncertainty is strictly our concern and the concern of those who shall follow us in the carrying on of the activities of the A.S.T.M.

Origin and Early History

First of all, I think we are interested in knowing how this happens to be our Fiftieth Annual Meeting when we as a Society are not yet fifty years old. Organized interest in the properties and testing of materials goes back even farther than that—to the formation at Munich in 1882 of the International Association for Testing Materials, with the objectives: "The development and unification of standard methods of testing; the investigation of the technically important properties of the materials of construction and other materials of technical importance, and also, the perfecting of apparatus used for that purpose."

Several congresses were sponsored by this International Association and by 1898 the Association had grown to 1526 members from 22 countries, with 106 members from the United States. It was in that year, 1898, that the American Section was formed at a meeting of 20 members at the Engineers Club in Philadelphia. This group promptly arranged for the First Annual Meeting, held at the Philadelphia Engineers Club on August 27, 1898, consisting of an afternoon and an evening session, attended by 30 of its 70 members.

I wish I might tell you of each of the meetings that followed, for each was of interest. Suffice it to say that these were expanded to cover two or three days with some including plant visitations. From the very start thoroughgoing discussions were held on some important problems of testing or some properties of materials on which more information was sought. In the first year a committee was appointed, consisting of Professor Hatt and Edgar Marburg, which later presented a report on the subject "The Present State of Knowledge Concerning Impact Tests." This comprehensive and thorough report was really the first technical paper published by the Society. But there were no simultaneous sessions at these early meetings. Not until the early 1920's did we catch up with that 3-ring-circus idea.

It was in the early years, too, that the forerunners of some of our most important committees were established. Those on steel, cement, paint, petroleum products, coal and coke, and wood were all active by 1904 or earlier and they continue now to function effectively.

We must always have an active body of working technical men. This is our greatest asset.

Society Incorporated—Learned by Doing

It was not long until the leaders at that period realized the need for a better type of organization than was possible in the American Section of the International Society—an organization which could function with more autonomy, provide protection with respect to individual liability, and permit more freedom of action in the matter of establishment of standards, particularly specifications, that would be useful in this country. In consequence, the American Society for Testing Materials was legally incorporated through the granting of a Charter on June 3, 1902, under the laws of Pennsylvania, and this Charter was unanimously adopted by the membership at the fifth Annual Meeting held June 12 to 14 here at Atlantic City. We might have wished for a more expressive title for A.S.T.M. but we take no issue with the statement of purposes; they are sufficiently comprehensive to include all activities in development and standardization of specifications, of methods and equipment for testing, as well as research investigations and publication of reports and papers dealing with the constitution, structure, and properties of engineering materials. Affiliation was maintained with the International Association until it ceased to function at the time of the first World War. With the granting of the Charter, a new organization was born, but the meetings it held were still of the same character as before and the numbering was continued. Therefore, while we are now celebrating our fiftieth Annual Meeting, we can still look forward to our real golden anniversary in 1952.

"The new Society had many ob-

[1] Manager of Testing Labs., The B. F. Goodrich Co., Akron, Ohio

stacles to overcome"—here I can do no better than to quote Professor Arthur N. Talbot, himself an early President of the Society—"It was without precedents. It learned to do by doing. It developed methods, procedure, standards. It encouraged research and recognized its value wherever found. It fostered cooperation. It coordinated the efforts of the many. Soon it had expanded its field and trebled and quadrupled the number of its working committees. Before long it had established a reputation for fairness of procedure, correctness of information, soundness of judgment, fullness of research data, and the stability of its organization. Its specifications and standards became accepted in the engineering world. The Society began to take a high place among the organizations in the technical field and to supply a most useful purpose to the business world. Besides, its activities gave opportunities and development to a body of young and growing members, which in itself was a high service to the industrial and engineering world well worthy of recognition."

Early Leaders

The Society was particularly fortunate in the selection of its first president and first secretary. Dr. Charles B. Dudley, chief chemist of the Pennsylvania Railroad, served as President from 1902 until 1909, and Dr. Edgar Marburg, Professor of Civil Engineering at the University of Pennsylvania, was Secretary-Treasurer from 1902 until 1918. These men of vision, courage, and organizing genius surrounded by a distinguished and talented group of pioneers in a new field laid the foundation and built the framework on which the Society has made such enormous progress. Among others who stand out in the group of charter signers, Professor Talbot mentioned Robert Lesley, attributing to him the valuable contribution of having poured oil on the sometimes troubled waters between groups of producers and consumers. To the name of Mr. Lesley, I would add that of Henry M. Howe. I was pleased to see the quotation from his annual address in 1902 that appeared in the May issue of the ASTM Bulletin, for it shows the sort of thinking that went into the Society and its operations. We are indebted to these early leaders for establishing the sound fundamental principles underlying A.S.T.M. work. From the very start everyone who had an interest was to be given an opportunity to participate in its deliberations. The pattern of cooperation thus set has permeated all A.S.T.M. activities.

Looking back, we might wish that less emphasis had been placed in those early days on the prompt promulgation of materials specifications until test methods had been more thoroughly perfected. We all realize that reliable, reproducible methods of measurement of properties are necessary prerequisites for the preparation of satisfactory, workable specifications. Much argument and criticism might have been avoided and ultimate progress expedited if there could have been more attention given to the cultivation of better understanding and more thorough standardization of methods of testing. However, the pressure for specifications is readily understood when the dire needs of industry for uniform materials in mass production are appreciated. Perhaps, too, the emphasis on specifications was not without merit in pointing up the need for exact test procedures, and it certainly was instrumental in promoting numerical growth and broad representation. It has been said that many producers first participated in the work of the Society to keep from being hurt by specifications formulated by consumers. These producers soon were persuaded of the advantages of wholehearted cooperation and remained as most interested and industrious workers.

Dr. Marburg was succeeded as Secretary-Treasurer in 1918 by our own Mr. Warwick, who had been associated with him over a number of years. I think that the Society is fortunate in having had, through Mr. Warwick and his staff, such intimate contact with those who were responsible for establishing its principles of operation. Several of the present staff knew a number of these men personally. They are familiar with the procedures that have been set up and the reasons for them. With their help, we shall continue to meet successfully one of our first responsibilities, that of reexamining from time to time the procedures established earlier and making modifications to keep them in tune with changing conditions. As our technical committees grow in size, new methods of operation must be devised—but we must continue to adhere to our basic principles of full representation and voluntary cooperation.

As our technical committees grow in size, new methods of operation must be devised—but we must continue to adhere to our basic principles of full representation and voluntary cooperation.

Work on Standards

The first dozen specifications which had been prepared and approved by the American Society, for the most part related to iron and steel. Incidentally, none of these standards covered methods of testing other than those included in the materials specifications, apart from inferred dependence on current practices. The number of specifications has continued to grow, and of late at a greater rate—there were 28 in 1910, 110 in 1915, double that number in 1920, and by 1930 we were well over the 500 mark. But in the period from 1940 to 1946 we completed almost another 500. In short, it took us about 30 years for the first 500, 10 years for the next 500, but only about 6 years for the most recent 500—a rapidly accelerating rate indicating true zeal and real worth in the activities in our committees. Of the present number of standards and tentatives, over 1400, more than half, are for test methods and definitions. Altogether, they deal with several hundred different materials and require nearly 7000 pages in five volumes for their publication. However, the mere number is less important than the acceptance that these standards have been accorded. They are written into building and other types of codes throughout the country. Many of them form the basis of business transactions representing a considerable bulk of the manufactured product of the na-

tion. They find wide use in control of our industrial production and process efficiency.

Here again, a very great responsibility is involved for maintaining the quality of these standards. I am sure our technical committees and the Administrative Committee on Standards keep this constantly in mind. We can depend on the able chairman of the latter, Mr. R. D. Bonney, to pursue this matter thoroughly. But it is not a responsibility of the committees alone. Every single member must be jealous of the quality of A.S.T.M. standards and see that any new addition that is made to the present number fully merits approval as such. The present ones need constant review to eliminate those that have outgrown their usefulness and to see that they keep abreast of developments in materials. New ones must be established where desirable and should be ready when needed. It is not enough to wait for demand. We should lead. For this, we must ever be alert to the advancing front of knowledge and to the development of new methods and techniques as well as to the introduction of new materials. For example, where application of statistical quality control methods will aid in production and assure greater uniformity, thereby helping both producer and consumer of a particular product, we should be working now to broaden our knowledge of these applications and to adapt our materials specifications to such programs. And again I would single out methods of testing. Our committees will need to give more and more attention to the question of the significance of tests and the evaluation of our test procedures. One of our most important standards today covers the verification of testing machines—testing testing machines if you will. Likewise, we need better means for the verification of our test methods. What do they show? How reliable are they?

Membership—Young Group

At the Annual Meeting in 1902 which approved the Charter, the membership was reported as 175, having more than doubled the original 70 of the American Section. During the following year this increased to 349. The members, then as now, worked in technical committees, of which five reported at the next annual meeting. Today, our membership is more than 6200, comprising individuals, companies, universities, government agencies, associations, and the like, from among whom nearly 4000 individuals are actively at work in some 70 technical committees on research and standardization problems. Their reports and standards command respect throughout the world. May I remind you that at this annual meeting alone we are having more than 350 meetings of our technical committees? We are particularly proud of our growth in personnel, for it indicates the very great interest in our stake in materials. We are responsible for seeing that this interest is maintained, as we must always have an active body of working technical men. This is our greatest asset. You will recall that Dr. Talbot, in the address quoted earlier, referred to the fact that the "activities (of the new Society) gave opportunities and development to a body of young members." That is important and must be maintained. We think of the founders as "Grand Old Men" and so they were—but in their day, they were far from being old, either in years or in ideas. Dr. Marburg was in his thirties when elected Secretary-Treasurer. We must do all we can to enlist the support of the young technologist in all our activities and particularly in our committee work.

Some Accomplishments

In reviewing the history of our founding and a few of the outstanding features of our growth, it is obvious that reference to many important activities of our Society has necessarily been omitted. It would be impossible within reasonable time limitations to begin to cover adequately the many phases of an organization which operates in a cross-section of all industry and is concerned with all sorts of technical activities. The magnitude of our $400,000 annual budget alone gives some idea of the extent of our operations. Mention might have been made of our District activities with eleven Councils established and holding meetings regularly in important industrial centers from coast to coast. Then, there are numerous publications in addition to our regular Book of Standards and *Proceedings*—the compilations of standards for individual industries, special books and pamphlets covering symposia and other presentations of technical information in selected fields, joint publications with other technical societies and our Bulletin which is rapidly approaching the status of a technical journal. These all help in our work of promoting and disseminating knowledge of the materials of engineering. Particularly important are certain of the research projects, some of which were initiated early in the history of the Society and which are continuing to aid greatly in the development of materials for special services. Among these may be mentioned the Society's work on Corrosion and Fatigue of Metals and the joint project with A.S.M.E. on the properties of metals at high and low temperatures. We need not dwell on our accomplishments; they are so generally accepted. Enough has already been said to establish without any doubt that our stake in materials progress has grown very large with the years and has brought with it grave responsibilities for the future.

Here, again, a very great responsibility is involved for maintaining the quality of these standards. Every single member must be jealous of the quality of A.S.T.M. standards and see that any new addition that is made to the present number fully merits approval as such.

The two World Wars were times when the value of Society work became particularly evident. Not only were its standards of inestimable worth, particularly in the last war in aiding procurement, but its committees and its personnel were called upon in large measure to aid in solving the many materials problems. In each instance the two wars emphasized the need for more information. At the time of the first war we would have liked to know the effects of increased phosphorus and sulfur limits in steel. Immediately following the war,

investigations were undertaken to solve this moot question. The recent war pointed out the need for a great deal more information on replacement materials in view of the many shortages that developed. Adequate data on the properties of some of the newer materials would have been of tremendous value. Data were lacking on the behavior of metals and other materials at high temperatures for use in gas turbine and jet propulsion engines. Many exposure conditions were encountered that required special treatment. There was need for protection methods and better packaging and handling procedures, to mention but a few.

Emphasis on Research

There is still much work to be done on standardization—utilizing and applying in new ways the vast store of technical information which has been accumulated. But the real opportunity in the future will, I believe, depend on extending our knowledge through much expanded emphasis on research. Great changes have taken place in the last decade (yes, even in the past two or three years) which will bring us face to face with materials problems so gigantic and perplexing that we cannot hope to meet them unless we delve more deeply in search of knowledge now unknown.

One outstanding way in which the necessary information is developed is by holding special symposia or round-table discussions, of which there are so many on the program for this Annual Meeting. These are all on the initiative of some committee or group and took no urging. For every one scheduled, probably many more could be held, limited only by the number of days available and the means for publication. There are almost as many already scheduled for the 1948 meeting in Detroit. In addition, many committees are sponsoring their own independent discussion sessions and at least one committee is thinking of arranging a lecture series. All of this indicates another big responsibility, that of publishing and disseminating the data. For while some of the discussions have served their purpose through accomplishing an exchange of ideas, many should reach publication to secure their full value.

We have prospered greatly in the past and are rich in material things far beyond the dreams of the early pioneers of our Society. We have freely used the technical information obtained by industry and brought to us by our members. We have asked them to undertake assigned research tasks and give us the results which they have generously and willingly done. I believe that all means of getting needed information should be fostered—the private institution, the individual research worker, organized committee effort and that being carried out by public institutions. And we should find the means of making this information available. I pass that along as a challenge to our good friends on the Administrative Committee on Research to attempt to work out some means for mobilizing all research efforts to bear on problems the committees have in hand.

Research Fund

Organized research, too, has its place. On special problems of particular interest to certain specific industries, we have gone to them and obtained substantial contributions of funds to finance the necessary research. In the case of corrosion, this has amounted over the years to more than $100,000, aside from contributions of materials. Similar smaller funds provided for the work on fatigue and the effect of temperature on metals, and other problems. Seldom, however, have our committees sought to determine through broad surveys what technical information might be useful and then initiated projects for obtaining it unless such projects were strongly supported by industry. Likewise, standardization has generally depended on prior accumulation by industry of the required knowledge. These methods of operation have not reflected lack of initiative but, rather, the taking in hand of immediate problems with no thought as to what could be done on a broad basis if the funds were available.

I propose that we again take up the matter of providing more adequately for research . . . if we really go to work on it, we will not fail. What a splendid accomplishment it would be if we could celebrate our next golden anniversary in 1952 with a Research Fund in keeping with the distinguished record of our past. Thus, we would in some measure assure the preservation of our stake in materials progress.

This situation has been repeatedly discussed in Presidential Addresses of the past. In 1931, Mr. K. G. Mackenzie called attention to the Research Fund of $8387.50, the income from which would not cover a single problem with one worker at some university or technical school. He then said, "There is work to be done; we must do it." Again in 1932, Dr. Clements pointed out that it behooves our Society to pin its faith to the continual search for and dissemination of new knowledge. He suggested that we greatly augment the principal of the Research Fund, and set a goal of $500,000. He further suggested private gifts of stock or money, the return to come to the donor for life and the principal at death to go to the A.S.T.M. Research Fund. He later gave point to the suggestion by setting the first example. The fund was again discussed in 1934 by Professor Lawson, but the country was still in the depths of depression and no tangible progress could then be made. Through gifts and resumption of the policy of adding to the fund from entrance fees, the principal has now grown to about $45,000, which is substantial but far short of that needed to provide sufficient income to finance research on any projects of general interest in the field of materials to be carried out, perhaps, under fellowships in universities or technical schools.

I am not suggesting that I think, by spotting research fellowships all over the country, we can just turn on a faucet, and get the answer to any problem. But frequently, I feel sure, there are investigations that could be greatly expedited if some research man could be assigned to a key problem. Sometimes a very little help would do much to finish a job already partly completed. Often a project needs a bibliography, and while we have been fortunate in this respect in finding public-spirited cooperators,

sometimes these individuals are not available. In some cases, the need is only a question of publication. Consider also a rather general investigation, as, for example, a study of one of the new composite materials. Can we expect the supplier of an individual component, of which perhaps only a small amount is used, to underwrite the investigation? Or can we depend on the potential user, faced with reaching a decision between this or a number of other products, to do all of the research work? Sometimes knowledge secured just for the sake of completing our knowledge may be worth while. Who knows?

There are many basic problems still unanswered. Among specific subjects which need research may be mentioned the property of hardness and its measurement, the fundamental nature of adhesion, the mechanism and measurement of abrasive wear, and there are many others. Their solution should not wait for the slow accumulation of funds from entrance fees nor for the death of some generous benefactor. We shall lose some of our stake in materials progress unless we find a way to continue to render the service which is expected of us.

Now that we have completed our new headquarters building and shall doubtless soon solve our other financial problems incident to operating under the changed economic conditions which face us, I should like to propose that we again take up the matter of providing more adequately for research. Dr. Clements' goal is none too large, and if we really go to work on it, we will not fail. What a splendid accomplishment it would be if we could celebrate our golden anniversary in 1952 with a Research Fund in keeping with the distinguished record of our past. Thus, we would in some measure assure the preservation of our stake in materials progress.

Ahead

The future holds so much in store, with the many new materials that should be explored, and the new methods needed to meet the many and diverse conditions that are being encountered. Low temperatures, high temperatures, humidity, enormous stresses, chemical corrosion—and soon, Dr. Marshall, our speaker of the evening, will no doubt present many more. We have recently organized a new Administrative Committee on Simulated Service Testing recognizing that frequently materials cannot be completely evaluated from a laboratory specimen of some restricted form but must be tested under actual use conditions. Apart from this, performance testing in general has always presented an inviting field.

With all these new types of test, new materials to be tested, new conditions to be met, it behooves us to be prepared.

As Tennyson wrote many years ago:

> "Yet I doubt not thro' the ages one increasing purpose runs,
> And the thoughts of men are widen'd with the process of the suns.
> Knowledge comes, but wisdom lingers, and I linger on the shore,
> And the individual withers, and the world is more and more."

The Effect of Air Circulation by Convection in the Test Tube Method of High-Temperature Aging of Synthetic Rubbers[1]

By A. E. Juve,[2] H. Boxser,[3] D. F. Reahard, Jr.,[4] S. R. Doner,[5] J. F. McWhorter,[6] C. G. Cashion,[7] G. D. McCarthy,[8] and R. M. Howlett[9]

THE Tentative Method for Heat Aging of Vulcanized Natural or Synthetic Rubber by Test Tube Method (D 865 – 46 T),[10] which was developed as the result of earlier work done by this committee[11] gives appreciably more reproducible results than the conventional air oven test when the exposure temperature is in the range of 250 to 300 F. However, the degree of deterioration for equal times of exposure is less by this method than by the oven method.

In commenting on the method, A. T. McPherson, of the National Bureau of Standards, suggested that the test could be improved by providing controlled circulation of air by convection along the lines of a method which had been previously reported.[12]

This report gives the results of a testing program carried out to evaluate this suggestion.

Procedure

The tests reported herein were run in six cooperating laboratories. The compounds used are given below and are identical in composition with compounds A and B used in the previous study.[11] (See table on next page.)

One laboratory did the mixing, curing, and dieing-out of the test

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to A.S.T.M. Headquarters, 1916 Race St., Philadelphia 3, Pa.

[1] The authors of this paper constitute a subsection of Section IV on Classification and Specifications of Rubber Compounds of Technical Committee A of A.S.T.M. Committee D-11 on Rubber and Rubber-Like Materials. This paper serves as a progress report of that group.

[2] The B. F. Goodrich Co., Akron, Ohio.

[3] Acadia Synthetic Division, Western Felt Works, Chicago, Ill.

[4] Enjay Co., Inc., New York, N.Y.

[5] Manhattan Rubber Division of Raybestos-Manhattan, Inc., Passaic, N. J.

[6] Ohio Rubber Co., Willoughby, Ohio.

[7] Firestone Tire and Rubber Co., Akron, Ohio.

[8] Chrysler Corp., Detroit, Mich.

[9] Standard Oil Development Co., New York, N. Y.

[10] 1946 Book of A.S.T.M. Standards, Part III-B, p. 977.

[11] G. D. McCarthy, A. E. Juve, H. Boxser, M. Sanger, S. R. Doner, E. N. Cunningham, J. F. McWhorter, and R. H. Croseley, "High Temperature Oven Aging of Oil-Resisting Synthetic Rubber Compounds," ASTM BULLETIN No. 132, January, 1945, p. 33.

[12] W. L. Holt and A. T. McPherson, "Accelerated Aging of Rubber in Air," *The Rubber Age*, Vol. 36, p. 121 (1934).

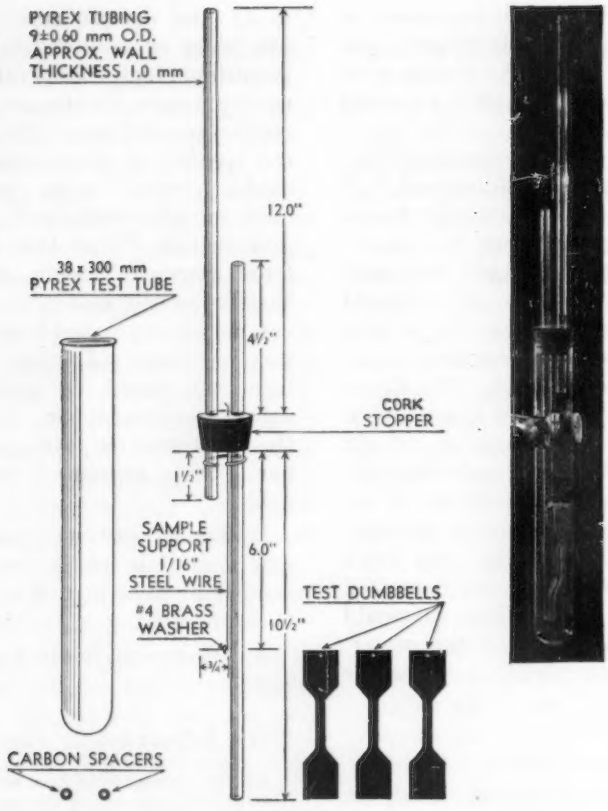

Fig. 1.—Arrangement of Vent Tubes and Samples.

	Compound A[a]	Compound B[a]
Hycar OR-15	50	50
Perbunan 26	50	50
Stearic acid	0.5	0.5
Age Rite Resin D	5.	5.
Zinc oxide No. 72	5.	5.
SRF Black (Gastex)	70.	70.
Sulfur		
Tuads	3.	3
Captax	1.5	1.5
Plasticizer SC	15.	
	200.	185.

[a] Cured 25 min. at 307 F.

specimens in order to reduce to a minimum possible errors from these sources.

Each laboratory ran tests on the two compounds three successive times under the following conditions:

1. Using stoppered test tubes in accordance with the present Method D 865,
2. Using air vent tubes with a "chimney" of 2 ft.,
3. Using air vent tubes with a chimney" of 1 ft., and
4. Using air vent tubes with a "chimney" of ½ ft.

The arrangement of the vent tubes and the samples is illustrated in Fig. 1. In each case three specimens were used per test.

Preliminary work at one of the laboratories had established the relationship between the rate of change of air and the height of the outlet vent tube when operating the test at 300 F. The following results were obtained:

Length Outlet Air Vent Tube, ft.	Average Intake Air Velocity, liters per hour	Average Number of Air Changes in Test Tube per hour
2.0	0.881	3.42
1.0	0.414	1.59
0.5	0.292	1.12

The results of the cross-testing program are given in Tables I to V, inclusive. Tables I and II give the average test results obtained by each laboratory and the standard deviations found for the nine individual specimens tested.

Tables III, IV, and V give the combined results for all laboratories. In Tables III and IV the results for the "no circulation" tests for laboratory B were omitted, since investigation of the high values for tension and elongation reported by this laboratory showed that rubber stoppers had been used instead of the cork stoppers prescribed by method D 865.

Additional work in one of the laboratories showed that in the "no circulation" method, the permeability of the stopper has a marked effect on the severity of the test. Tests using cork, cork wrapped with lead foil, cork coated with butyl rubber, and rubber stoppers showed that as the gas permeability of the stoppers is decreased the severity of the aging (based on change in elongation) is decreased.

The results from laboratory D shown in Tables I and II are so markedly different from those obtained by the other laboratories, for both the circulating and noncirculating tests, that there is some reason to suspect that the test procedure used must have differed in some respect from that prescribed. However, these results have not been omitted from subsequent calculations.

The data shown in Tables III, IV,

TABLE I.—VARIATION OF TESTING RESULTS BY LABORATORY FOR COMPOUND A.

Testing Laboratory	Height of Vent Tube, ft.	Number of Tests	Average Tensile Strength, psi.	Standard Deviation, σ, in Tensile Strength, psi.	Average Elongation, per cent	Standard Deviation, σ, in Elongation, per cent
A	2	9	1025.6	55.6	100	8.16
	1	9	1036.7	103.4	101.1	2.78
	½	9	947.8	115.0	95.6	8.32
	Control	9	1080	103.1	160	38.3
B	2	9	1362	102.6	127	8.16
	1	9	1227	145.8	123	11.05
	½	9	1298	346.6	127	12.7
	Control[a]	9	1723	102.5	287	16.3
C	2	9	1125	118.3	101	9.94
	1	9	1095	115.8	105	8.65
	½	9	1032	103	98	10.3
	Control	9	...	...	...	...
D	2	9	947	63.4	72.2	4.16
	1	9	930	72.1	70.0	4.72
	½	9	843	64.4	58.9	3.15
	Control	9	888	45.2	53.0	4.72
E	2	9	1030	170.8	108	30.4
	1	9	1105	190.3	109	28.5
	½	9	1073	161.3	112	24.84
	Control	9	1240	392	192	79.6
F	2	9	1003	113.9	93	6.45
	1	9	908	122.5	91	6.13
	½	9	938	84.6	90	5.4
	Control	9	978	119.7	129	32.9

[a] Rubber stoppers used.

TABLE II.—VARIATION OF TESTING RESULTS BY LABORATORY FOR COMPOUND B.

Testing Laboratory	Height of Vent Tube, ft.	Number of Tests	Average Tensile Strength, psi.	Standard Deviation, σ, in Tensile Strength, psi.	Average Elongation, per cent	Standard Deviation, σ, in Elongation, per cent
A	2	9	1164	55.5	80	6.66
	1	9	1167	77.1	77.8	7.85
	1/2	9	1142	55.5	77.8	7.85
	Control	9	1294	254.7	134	45.1
B	2	9	1244	91.2	79	12.4
	1	9	1103	148.4	64	12.4
	1/2	9	1214	55.8	83	6.1
	Control[a]	9	2137	178.4	234	26.8
C	2	9	1201	89.5	83	3.65
	1	9	1252	87.4	83	11.50
	1/2	9	1176	42.6	84	6.88
	Control	9	...	...	...	...
D	2	9	964	21.2	52.2	4.15
	1	9	1062	48.3	56.7	4.72
	1/2	9	1047	52.1	55.6	4.94
	Control	9	979	37	53	4.72
E	2	9	1230	40.4	88	20.4
	1	9	1198	96.3	85	16.4
	1/2	9	1170	170.9	81	20.2
	Control	9	1116	340	110	51.9
F	2	9	1073	106.2	79	5.63
	1	9	1020	79.9	79	5.66
	1/2	9	1107	100.4	83	5.66
	Control	9	988	47	94	6.47

[a] Rubber stoppers used.

and V show that the variations in chimney height over the range tested had no measurable effect on the results obtained, that the degree of deterioration (based on elongation loss) with circulation was greater than that found in the noncirculating tests and that the reproducibility of the test was appreciably improved by introducing circulation by convection. The heat-loss results were somewhat scattered and show no well-defined relation to the velocity of air circulation. However, the losses in the circulating air tests were generally higher than those in the noncirculating tests. Compound A, which contains plasticizer SC, showed a greater loss than Compound B.

In Tables III and IV the values shown in parentheses are derived from data previously reported[11] and show that the reproducibility found in this test program checks fairly well with that previously found.

TABLE III.—COMBINED DATA—COMPOUND A.

Height Vent Tube, ft.	Average Tensile Strength, psi.	Standard Deviation in Tensile Strength, psi.	Average Elongation, per cent	Standard Deviation in Elongation, per cent	Number of Tests
2	1082	176.8	100	21.7	54
1	1050	168.9	100[a]	21.6[a]	54
1/2	1022	183.1	97	24.5	54
No circulation	1046 (960)[b]	246.2 (268)	134 (79.0)	69.8 (34.2)	36 (42)
Not aged	1930 (1818)	76.6 (92)	647 (851)	39.9 (29.6)	15 (12)

[a] 53 tests were reported.
[b] Values in parentheses from data previously obtained.

It was observed in the course of the circulating air tests that considerable material was deposited on the inside of the exhaust tube. This consisted principally of colorless crystals which were identified as tetra methyl thiourea and dimethyl ammonium dimethyl dithiocarbamate.

Conclusions and Recommendations

By modifying the present test-tube method of high-temperature aging to permit air circulation by convection, the test is made appreciably more severe, but at the same time more reproducible.

The velocity of air circulation under the conditions used here, which varied over a three-fold range from 1.1 to 3.4 changes of air per hour, did not affect the results obtained.

The loss in weight during aging was somewhat greater in the circulating air tests than in the stoppered tube tests.

TABLE IV.—COMBINED DATA—COMPOUND B.

Height Vent Tube, ft.	Average Tensile Strength, psi.	Standard Deviation in Tensile Strength, psi.	Average Elongation, per cent	Standard Deviation in Elongation, per cent	Number of Tests
2	1146	132.3	77	16.3	54
1	1134	124.9	74	15	54
1/2	1143	106.1	77	14.2	54
No circulation	1094 (1233)[a]	250.7 (277)	98 (88)	45.5 (48.7)	36 (42)
Not aged	2286 (2099)	178 (818)	536 (646)	24.3 (27.5)	15 (12)

[a] Values in parentheses from data previously obtained.

The poorer reproducibility of the stoppered test-tube method over the circulating air method is thought to be due to variations in the permeability of the stoppers used. The more impermeable the stopper the less severe is the test.

It is recommended that the present test-tube aging method D 865 be amended to require the use of a pair of glass tubes extending through the stopper using the dimensions and arrangement illustrated in Fig. 1.

TABLE V.—PERCENTAGE LOSS IN WEIGHT OF AGED SAMPLES FOR COMPOUND A AND COMPOUND B.

Compound	Number of Tests	Vent Tube Height, ft.	Average Loss of Weight, per cent	Standard Deviation, σ, per cent
A	27	2	1.36	0.30
	27	1	1.40	0.42
	27	1/2	1.21	0.33
	27	No circulation	1.07	0.38
B	27	2	0.85	0.28
	27	1	0.84	0.21
	27	1/2	0.67	0.24
	27	No circulation	0.41	0.19

New Apparatus for Axial-Load Fatigue Testing

By William N. Findley[1]

SYNOPSIS

A fatigue testing machine is described which permits testing of specimens in axial tension or compression. The machine is designed with provision for detecting and correcting strains introduced into the specimen when it is fastened to the machine. Thus the stress in the specimen may be made more nearly uniform over the cross-section of the specimen than is usually possible with axial-load fatigue machines not having such an adjustment.

MOST fatigue testing of materials has been performed with apparatus designed to subject a specimen to bending. This has been the result of two factors: (1) bending was the type of loading for which fatigue failure was first observed and is still probably the type of repeated loading involved in the majority of applications where the possibility of fatigue failure must be considered, and (2) the apparatus for fatigue testing in bending is probably the easiest to construct.

Many fatigue data have, however, been obtained with apparatus which subjects specimens to twisting and to tension or compression. Tension or compression fatigue testing under axial loads has been preferred for many studies for various reasons, three of the more important of which are: that it is possible with such apparatus to study the effect of ranges of stress in which the mean stress of the cycle is in compression for both notched and unnotched specimens; that the stress in the unnotched specimens can be calculated even for ranges of stress which cause yielding of the material; and that the stress gradient across an unnotched specimen is zero (which eliminates one variable whose influence is not fully understood).

In spite of these advantages of axial-load fatigue machines, their use has not been as extensive as that of bending fatigue machines (except for tests of riveted, bolted, or cemented joints, etc., for which the bending machines are unsuitable). This is due to several factors among which are cost, more involved procedure in setting up specimens, and unknown stresses introduced in the specimens when the specimens were attached to the machine (especially when the range of stress involves compression stresses). The apparatus described in this paper was developed to minimize the last two factors, that is, to provide means of detecting and correcting for stresses which were not desired while at the same time making the apparatus as simple to operate as possible.

Apparatus:

The axial-load fatigue testing machine developed for testing specimens in ranges of stress involving compression as well as tension is shown in Fig. 1. This machine has a capacity of about 3000 lb. and is of the constant-amplitude-of-deflection type. A larger machine of 15,000-lb. capacity has been fitted with the same type of gripping device (chucks) and provided with the same type of apparatus for detecting and correcting undesired stresses in the specimen. The chucks and correction apparatus for this machine are shown in Fig. 2.

All four of the machines built to date are of the constant-amplitude-of-deflection type. However, the apparatus to be described can be used equally well with constant-amplitude-of-force type machines. Such a machine is under construction.

The complete apparatus is shown in Fig. 1 whereas the device to be called the detector has been removed in Fig. 2 so that this machine is shown as it appears in operation. The specimen is located in the vicinity of *A* in both Figs. 1 and 2. It is subjected to axial strains imposed by a lever *B* (Fig. 1) which has flexible pivots and is deflected in a vertical plane by a motor *C* driving through a connecting rod *D* and adjustable-throw crank *E*. Linear motion of the chucks to which the specimen is fastened is provided by a parallel bar linkage *F* (Figs. 1 and 2). Flexible pivots in all linkage eliminate the problem of wear and seizure of mechanical joints. A counter (not shown) is attached to the rear end of the motor shaft and serves to indicate the number of cycles to which the specimen is subjected. The machine operates at 1750 rpm.

The loads applied to the specimen are indicated by a dynamometer ring *G* equipped with a dial (or resistance strain gages). The machine is stopped upon failure of a specimen by a microswitch (or electrical contacts) located at *H*. The microswitch is arranged to open a pilot circuit in the starting relay when the deflection of the dynamometer ring and other parts of the machine decrease a predetermined amount. The machine is designed with provision for detecting and correcting strains introduced into the specimen when it is placed in the grips *I* of the machine. Such initial strains are inevitable in clamping a specimen to two restrained chucks, and restrained chucks are necessary for tests of specimens in axial compression in order to prevent buckling.

The device used to detect initial strains consists of means for measuring six components of distortion in the upper end of the specimen with respect to the lower end. Axial (vertical) load is detected by readings of the dynamometer dial *G* (Figs. 1 and 2). Displacement in either of two horizontal directions, bending in either of two planes, and twisting are indicated by means of five small dials indicating relative movement of two aluminum plates *J* (Figs. 1 and 3) which are clamped by split collets to the upper and lower straight sections of the specimen. These plates and attached dials constitute a removable fixture (detector) which is shown in Fig. 3. The detector is balanced statically

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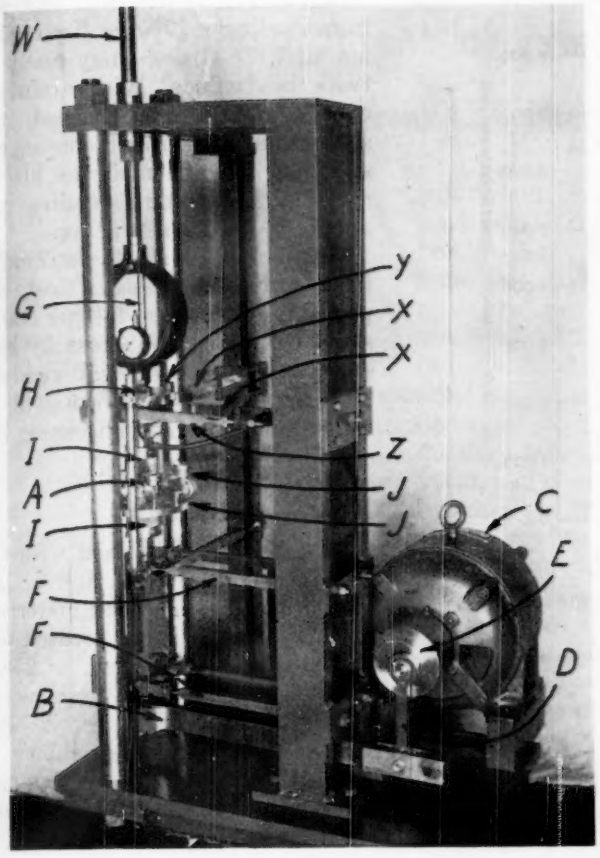

Fig. 1.—3000-lb. Axial-Load Fatigue Testing Machine with Distortion Detector and Correction System.

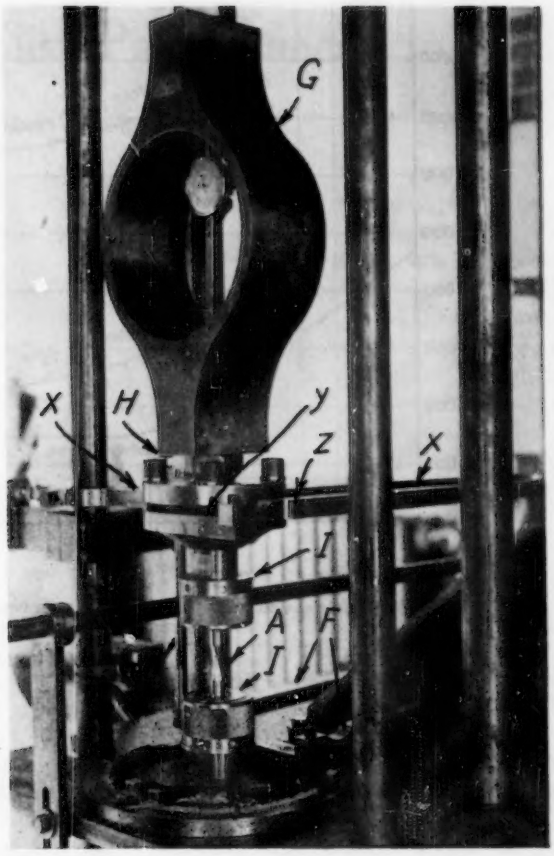

Fig. 2.—Correction System and Grips as Applied to 15,000-lb. Axial-Load Fatigue Testing Machine.

about the center line of the specimen.

The dials K and L (Fig. 3) respond directly to bending of the specimen in two planes at right angles to each other. Dials M, N, and O respond to both twisting about the axis of the specimen and to horizontal displacement of the upper end of the specimen relative to the lower end. Twisting may be differentiated from front-to-back displacement by noting the relative readings of dials M and N—equal readings of opposite sense indicate twisting, equal readings of the same sense indicate front-to-back displacement. When twisting is accounted for by means of dials M and N then side-to-side displacement can be determined from dial O.

Before a specimen (of either size, P, Q (Fig. 3)) is placed in the machine, the detector is clamped to the specimen by means of split collets such as R (Fig. 3) and the five dials are set to zero.

The specimen is then fastened to the machine by means of special collet-type chucks I (Figs. 1 and 2), which are so designed that the specimen and detector can be inserted in the machine without moving the heads of the machine from their normal position. The parts of which the chucks are composed are shown in Fig. 3. The pedestal S which screws into the testing machine is placed inside of the nut T which is used to draw the ring U over the tapered collet V thus tending to collapse the collet and hold it firmly against a boss on the pedestal S. The slot in the ring U matches a key on the pedestal to prevent rotation of the ring while nut T is tightened. The collet is split and both collet and specimen are threaded so as to provide a positive grip on the specimen.

When the specimen is tightened in the chucks, deflection of the dials indicates distortion of the specimen due to clamping in the chucks. These distortions may be removed by means of a six-component correction system consisting of an axial displacement screw W (Fig. 1), two links X (Figs. 1 and 2) to adjust the

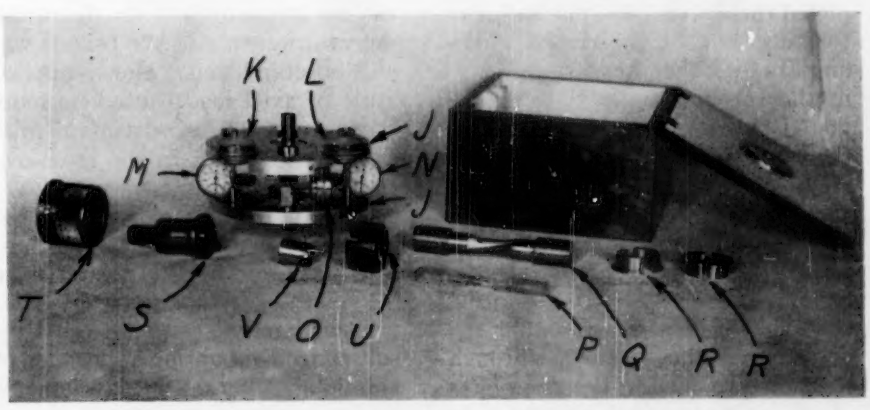

Fig. 3.—Distortion Detector, Parts of Specimen Grip and Specimens.

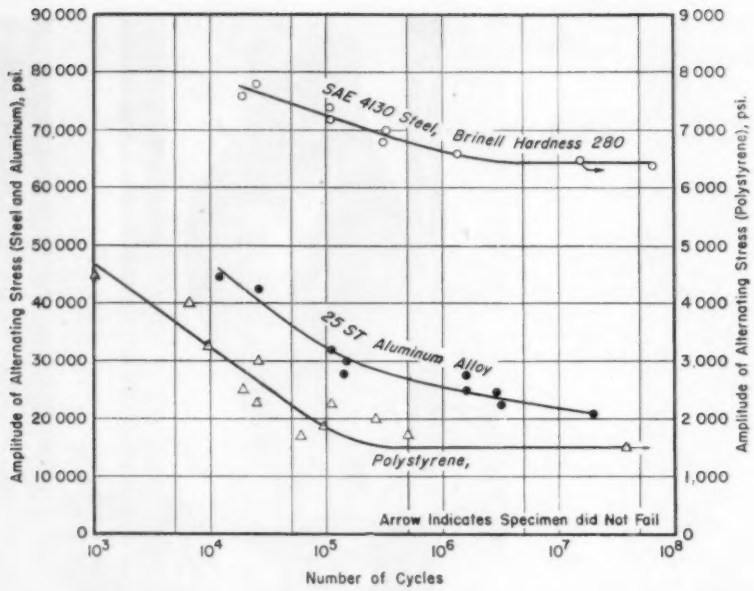

Fig. 4.—Axial-Load Fatigue Data for Three Materials (Mean Stress Zero).

Data for SAE 4130, Courtesy J. O. Smith. Data for 25S-T and Polystyrene, Courtesy R. L. Sutherland.

upper chuck from side-to-side and from front-to-back, a wobble plate *Y* and four adjusting screws for tilting the upper chuck a slight amount about either of two horizontal axes, and a tangent link *Z* for rotating the upper chuck about the axis of the specimen. The axes of tilting or rotation, and the directions of the displacement adjusting links coincide with those of the indicated rotations or displacements shown by the detector. Thus each correction can be made nearly independently. That is, each adjustment affects other adjustments to some extent because it was not possible to locate the pivot-points of the flexible links and the centers of rotation at the center of the specimen, which is the optimum location.

When the adjustments are completed there should be no bending or twisting of the specimen. The amplitude-of-the-alternating stress in the specimen may then be adjusted by means of the adjustable-throw crank *E* and the range of stress (mean stress or maximum stress) by means of the axial displacement screw *W*. After all adjusting screws are tightened the detector is removed by withdrawing the collets *R* (Fig. 3) and sliding the detector off the specimen through the slots provided in the two plates of the detector. The spindle of the dynamometer dial is disconnected from the dynamometer ring *G* and the test is then ready to be started.

Strain measurements made on a specimen of 25S-T aluminum alloy by means of SR-4 strain gages indicated that the pressure of the main springs in the dials of the detector caused stresses of about 1000 psi. in the specimen. Removing the main springs from the dials and replacing them by spring clips to hold the dial plungers in contact with the pins in the lower plate, *J*, Fig. 1, reduced the stress caused by the dials to about 100 psi.

After this refinement had been made it was found that bending stresses left after the machine had been adjusted by the correction system in accordance with the indications of the dials of the distortion detector were about 400 psi. It was also observed that a slowly applied cycle of axial load caused no more than about 100 psi. deviation from the average stress in the cross-section of the aluminum specimen.

Stresses calculated from the distortions shown by the detector indicate that even with the greatest care in mounting a specimen by conventional methods the stresses resulting from mounting a specimen of aluminum alloy 0.2 in. in diameter would seldom be less than 4000 psi. from bending or 2000 psi. from twisting, and the stresses may easily be twice these values. With careful use of the apparatus described, the stresses resulting from mounting the specimen may be made as low as about 400 psi. from bending and about 200 psi. from twisting.

Changes in the stress distribution in a specimen during a test will probably occur when fatigue cracks start or when the stress is high enough to produce local yielding. The apparatus described will of course not prevent such changes in stress.

Examples of Test Data:

S-N diagrams obtained with the apparatus described above are shown in Fig. 4 for three materials: an SAE 4130 steel heat-treated to a hardness of 280 Brinell, a 25S-T aluminum alloy and a transparent plastic (polystyrene). *S-N* diagrams obtained on machines in which the stresses due to clamping the specimen in the machine are not controlled may differ markedly or very little from results obtained with the present equipment, depending on the magnitude of the change in the range of stress or the state of stress produced in the material by the unknown bending and twisting stresses, and depending also on how much the fatigue strength of the particular material is affected by small changes in range of stress and state of stress.

Acknowledgments:

The work reported herein was a part of the work of the Engineering Experiment Station, Mr. M. L. Enger, Director; in the Department of Theoretical and Applied Mechanics, Mr. F. B. Seely, Head. Financial assistance in part of this work by the Plastics Division of the Monsanto Chemical Co., Mr. N. N. T. Samaras, Director, is gratefully acknowledged.

The courtesy of Messrs. J. O. Smith and R. L. Sutherland in making available the test data shown is appreciated. The author is greatly indebted to Messrs. W. B. Kranz and G. H. Steward for assistance in the design and construction of the apparatus described.

Measurement of Metal Polish Performance*[1]

By Frank E. Clarke[2] and Robert C. Adams[2]

METAL polish is an essential item of military supply. This is particularly true in peacetime when it serves not only its functional purpose but also is extremely useful in indoctrination, training, and discipline. Consideration of the miles of brass railing, thousands of door knobs, and hundreds of ship's bells suggests that an organization of the size of the Navy will consume enormous volumes of metal polish each year. It is used by virtually every individual in the Navy and on a wide variety of metals in all conditions, from those which are slightly tarnished to surfaces bearing a heavy patina of age. The common interest of all users is the end result, a lustrous finish. The amount of polish used, the labor required to develop a luster, or the extent of damage to the polished surface are of distinctly secondary importance to the polisher or his supervisor. It is apparent, however, that any improvement in the performance of the metal polish would reduce both the amount of polish consumed and the man-hours of labor required for maintenance of brightwork.

Previous Methods of Measurement

Government agencies must purchase in accordance with specifications, so that any improvement in the performance of metal polish must be preceded by measurement and specification of that performance. Specification of composition is not effective because a change in composition from that of a satisfactory polish so slight as to be almost undetectable by analysis may result in gumming of the surface in use so that a high gloss can scarcely be achieved.

Several years ago an effort was made to provide a performance specification[3] for metal polish. By the method then employed, a large sheet of brass was tarnished by drenching it with ammonium hydroxide. After drying and aging for 24 hr., half of this sheet was polished by hand using a material which service reports indicated as satisfactory and which therefore was considered the reference standard. The other half of the sheet was similarly polished with the material under examination. After the two polishing operations, the operator decided whether the polish under test had removed the tarnish as readily and had developed as satisfactory a gloss as the standard polish. If he considered the tested polish to be at least equivalent to the standard, the former was accepted. The abrasiveness of polishes was measured by a more objective method. In this test a weighed disk of brass was rotated on a vertical axis at a controlled speed under controlled load against a disk of cloth saturated with the polish under test. The loss in weight of the disk during the standard test period provided a measure of abrasiveness.

Tests whose results are expressed as the opinion of the operator lend themselves readily to misinterpretation and are frequent causes of dispute. A further effort therefore was made which has resulted in the development of procedures by which a quantitative and reproducible measurement of metal-polish performance can be obtained.

Development of Polishing Machine

The first requisite of a procedure for testing metal polishes is a machine to do the polishing which in actual use is done manually. The polishing machine should provide in a reproducible manner close simulation of the conditions of actual use. The polish should be applied to a cloth and then rubbed over the metal surface at a speed and under a pressure approximating those of manual polishing. In manual polishing the pattern of successive strokes is largely random so that in the polishing machine the strokes should cross the specimen at varying and changing angles and in such a way as to avoid any repetitive or cyclic pattern of the strokes. It is improbable that any simple rotating or

[3] Navy Department Specification 51-P-5e; Polish, Metal, Liquid, 1 May, 1935.

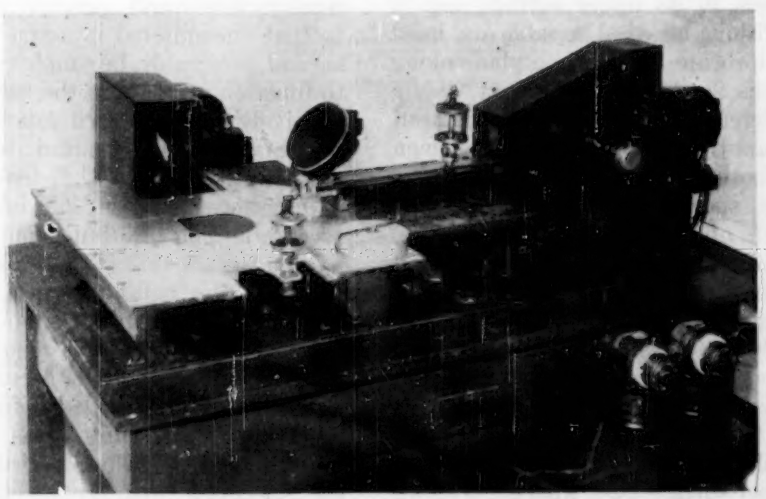

Fig. 1.—Polishing Machine Before Starting Test, with Tarnished Specimen in Place in Table, Clean Cloth on Polishing Head, and Lead Weight Ready to Apply When Head Folds Down.

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[1] The opinions expressed in this paper are those of the authors and are not necessarily official opinions of the U. S. Naval Engineering Experiment Station or the Navy Department.

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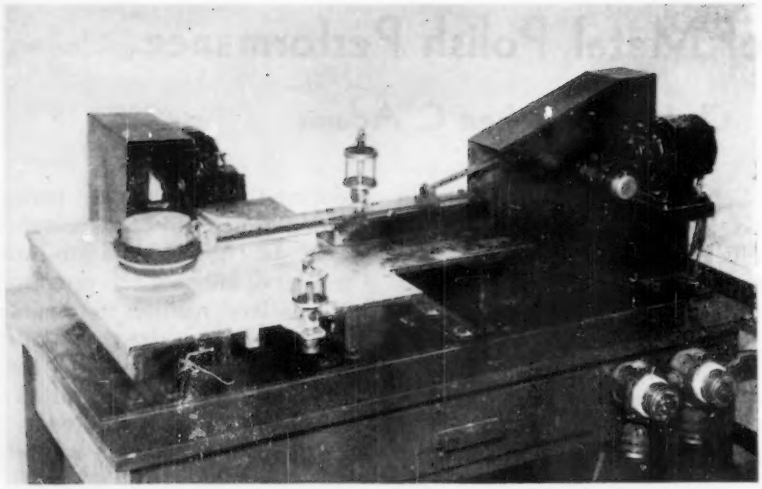

Fig. 2.—Polishing Machine During Test, with Polish on Head and Table and Partially Polished Specimen in Center Front.

reciprocating device could achieve this objective. The simplest possible design should be sought because the cost of construction and the difficulty with replacement and repair increase with complexity in the design. Finally, normal cleaning and maintenance of the machine should be easily accomplished by comparatively untrained personnel.

A system of double reciprocation was selected as the simplest which would insure the absence of a repeating polishing pattern. This principle was adapted to the design of a machine employing a 4-in. square specimen, which was the smallest appropriate to the reflectometer to be used. The resulting machine is illustrated in Figs. 1 and 2. It consists of a polishing table which holds the test specimen in a recess in its upper surface, and a polishing head. The table and head reciprocate in the same plane along paths 90 deg. apart and at widely different speeds. The polishing head clears the path of the test specimen at both extremities of its path; the test specimen likewise clears the path of the polishing head. The gear motors driving the table and head rotate at 9.6 and 57 rpm., respectively. The least common multiple of these two speeds is high enough so that it requires 16 min. of operation before the polishing pattern repeats. The specimen table moves on rails supporting its upper surface flush with fixed tables on either side, the rails being lubricated with a drip-feed oiler. The polishing head is hinged to the end of the reciprocating shaft, which is similarly lubricated. The head consists of a 4-in. disk of soft rubber, 1 in. thick, which is cemented to a 4-in. circle of $\frac{1}{4}$-in. steel plate. There is a hole in the center of the upper surface of the polishing head to receive the dowel of a 5-lb. lead weight which is placed on the head during actual polishing. A circle of billiard cloth is stretched over the rubber face of the polishing head and held in place by a circular, helical spring in a continuous notch in the steel plate of the head.

Development of Tarnishing Procedure

A suitable standard tarnishing procedure is a necessary prerequisite for mechanical evaluation of polishes. The method of application must reproducibly yield tarnish similar to that encountered in actual service and, preferably, be simple enough to function properly in the hands of relatively inexperienced laboratory personnel. The standard tarnish must resist removal sufficiently to differentiate between inferior and acceptable polishes, but should not be so adherent that it unnecessarily increases the polishing cycle. An accurate, reproducible method of measuring tarnish also is required.

Numerous methods of tarnishing were tried and discarded before an acceptable procedure was discovered. These included: brushing the specimen with cold, concentrated ammonium-hydroxide; immersing the specimens in the same reagent; immersing the specimens in warm hydrogen-sulfide solution; and exposing the panels to the vapors of ammonium hydroxide at various concentrations and temperatures. Brushing yielded a heavy, extremely nonuniform deposit. Immersion produced very thin, spotted, easily removable tarnishes. The tarnish obtained by fuming was a gray-brown oxide film which increased in density on increasing either the temperature or the concentration of the ammonium-hydroxide solution. At low temperature and low concentrations the oxide film was thin and uniform, while at higher temperatures and concentrations it was heavy and spotted. A mid-point was selected which yielded proper density and uniformity.

In the selected procedure, the brass specimens are tarnished by exposing them to the fumes of 25 per cent ammonium hydroxide solution (25 ml. of concentrated NH_4OH per 100 ml.). This liquid, contained in an 800-ml. beaker and maintained at 100 F. with a constant-temperature bath, is allowed to vaporize against the polished face of the specimen inverted on the beaker top. Specimens are maintained at a temperature of 85 to 87 F. prior to exposing them to the vapors. Each is exposed to a fresh charge of 25 per cent ammonium hydroxide for a period of 150 sec. The gray-brown, service-like tarnish produced by this procedure has an extremely low reflectance, disappears uniformly on polishing, and is sensitive enough to differentiate polishes which exhibit very small differences in polishing efficiency. The temperature of the brass specimen is not automatically controlled in this test, and application at room temperatures below 70 F. may result in excessive condensation on the specimen and consequent heavy, spotted tarnish. Room temperatures above 90 F. do not permit sufficient condensation and thus yield extremely thin tarnish. Acceptable tarnish will result if the specimen is very slightly cool to the touch (unconditioned skin) immediately prior to placing it on the vapor generator.

The uniformity of the tarnish obtained by the fuming procedure is influenced by the condition of the surface to which it is applied. A

TABLE I.—UNIFORMITY OF REFLECTANCE OF PREPOLISHED AND TARNISHED BRASS SPECIMENS—SUMMARY OF RESULTS ON 25 SPECIMENS, READINGS ALONG TWO AXES OF EACH, OVER A 2-YR. PERIOD.

Condition of Specimen Surface	Angle of Incident Light, deg.	Reflectance, Percentage of Incident Light		
		Mean	Range	Standard Deviation
Prepolished	45	74.58	9.1	2.19
Prepolished	60	75.33	14.4	2.82
Prepolished	75	77.01	17.0	3.41
Tarnished	45	0.168	0.55	0.133
Tarnished	60	−0.068	0.34	0.099

pitted surface may develop a tarnish which is extremely difficult to remove while an insufficiently prepolished, unpitted surface may develop a final gloss exceeding that of the original surface. Control of both is attained by first measuring the reflectance of the prepolished surface to insure that it is above a satisfactory minimum, which approaches the maximum gloss attainable on the specimen brass employed, and then checking the reflectance of the tarnished surface to keep it near the minimum measurable level.

Measurement of Reflectance:

All reflectances are measured with a Hunter Multi-Purpose Reflectometer.[4] This is a twin-photoelectric-cell, null-type instrument in which a filtered light beam is split by a mirror so that one half is reflected from the surface being measured to one cell, while the other half is reflected from a comparison surface to the companion cell. The logarithmic scale of the instrument is set to a reference point in the appropriate range prior to each series of readings using chromium or black glass standards calibrated by the National Bureau of Standards. A correction curve supplied with the instrument is employed for final correction of scale readings to percentage of incident light reflected by the measured surface. Measurements are made at angles from the normal of 45, 60, and 75 deg. and along both axes parallel to the sides of the specimens, a total of six measurements per surface, to insure against nonuniformities in either the tarnish or its removal.

A summary of the measurements on 25 successive specimens is shown in Table I. Prepolishing is done manually and the tabulated results evidence the moderate variation obtained by polishing until the reflectance at all three angles is at least 70 per cent. The reflectance of the tarnished specimens is so slight that no control can be applied other than the insurance that none shall be greater than 0.5 per cent. Reflectance readings at 60 deg. on the tarnished specimens are below the reliable range of the reflectometer, as evidenced by the preponderance of negative readings, and those at 75 deg. are completely meaningless and so are not shown in Table I.

[4] National Bureau of Standards Research Paper 1345, November, 1940.

Development of Polishing Procedure

The standard tarnish discussed above was used in developing a suitable polishing procedure. Preliminary polishing studies were made with the former reference polish by subjecting a succession of tarnished specimens to a series of 4-min. polishing periods. At the beginning of each series, 5 ml. of polish were added to the circle of billiard cloth on the polishing head to wet it as in service, and 5 ml. were poured onto the center of the tarnished specimen to permit solvent action of the polish. Additional 5-ml. increments were added to the specimen after each minute of operation. This period represented approximately the time required for the polish increment to dry on the polishing table. Specimens were not disturbed in the table during the 4-min. periods, but were rotated through 90 deg. at the start of each new period. Periodic reflectance readings made during this preliminary study revealed wide differences not only between duplicate specimens but also between the two axes of the same specimen. These variations appeared to depend upon the position of the specimen during the polishing period immediately preceding the reflectance reading.

The next study was conducted using a series of 1-min. polishing periods with a pause after each for rotation of the panel and addition of polish. Reflectance measurements were made after alternate minutes, and polishing was continued until it became evident that the reflectances were approaching the attainable maxima. The reference polish yielded excellent agreement between the axes of each specimen, and satisfactory agreement between the average reflectance values for quadruplicate determinations. The survey of the data indicated that the tarnish started breaking away rapidly after 8 min. of polishing and that there was negligible increase in gloss after 20 min.

The polishing procedure having demonstrated its reproducibility

TABLE II.—COMPARATIVE PERFORMANCE OF FOUR METAL POLISHES—SUMMARY OF RESULTS USING FOUR SPECIMENS WITH EACH POLISH.

Metal Polish	Angle of Incident Light, deg.	Reflectance, Percentage of Incident Light					
		Tarnish Removal			Final Gloss		
		Mean	Range	Standard Deviation	Mean	Range	Standard Deviation
A	45	34.69	4.6	1.54	58.10	3.7	1.37
	60	35.09	3.4	1.58	58.41	2.3	0.87
	75	43.42	4.4	1.33	63.02	3.7	1.54
	Average	37.73	(51.6 per cent restoration)		59.84	(81.8 per cent restoration)	
B	45	55.41	9.8	3.79	65.66	5.1	1.49
	60	53.28	14.5	7.91	66.34	3.9	1.13
	75	62.06	15.1	3.19	70.39	4.2	2.35
	Average	56.92	(77.5 per cent restoration)		67.46	(91.8 per cent restoration)	
C	45	52.32	5.0	1.66	67.40	5.5	1.74
	60	50.38	4.8	1.57	67.46	4.3	2.13
	75	61.42	8.7	2.61	71.20	6.4	1.95
	Average	54.71	(71.5 per cent restoration)		68.69	(89.7 per cent restoration)	
D	45	55.19	5.1	1.79	67.84	4.3	1.53
	60	50.90	4.0	1.58	65.74	3.0	1.12
	75	60.01	7.3	2.25	70.31	9.4	3.09
	Average	55.37	(73.3 per cent restoration)		67.96	(89.9 per cent restoration)	

with a single polish, the next step was its trial with several polishes in order to standardize the procedure and determine appropriate specification limits. Multiple tests were made on eight polishes, all of which had previously been purchased for Naval use, making reflectance readings on each specimen at 2-min. intervals during the polishing. The results of these tests showed that the better polishes removed the tarnish almost completely in 4 min. and developed a gloss closely approaching that of the prepolished specimen in only 10 min. Discrimination between good and inferior polishes deteriorated after longer polishing periods. The standard procedure adopted consisted of ten 1-min. polishing periods; starting with 5 ml. of polish each on the specimen and on the polishing head; rotating the specimen 90 deg. in its recess and adding 5 ml. of polish to the specimen after each period; reading the reflectance of the specimen for evaluation of tarnish removal after 4 min.; and making the final reflectance readings at the end of 10 min. of polishing.

Replicate determinations on the eight polishes by the standard polishing procedure provided a basis for selection of appropriate specification limits. Two of the eight polishes were distinctly inferior in both tarnish removal and development of gloss. Results from tests of the other six were closely grouped so that selection of minima just below their performance provided suitable specification limits. Incorporated in the resulting specification[5] were these limits: 65 per cent restoration of original gloss for tarnish removal and 90 per cent restoration (with no single reading below 85 per cent) for final gloss. These limits have proved satisfactory in the inspection testing of innumerable polishes submitted since.

Reproducibility of Tarnishing and Polishing:

Table II is a summary of tarnish-removal and final-gloss results of four representative polishes. Four, instead of the usual two, specimens were used with each polish to provide a total of eight reflectance readings at each angle. The distinct inferiority of polish A is clearly evident, and satisfactory reproducibility, except for tarnish removal by polish B, is shown by the uniformly low standard deviations.

[5] Navy Department Specification 51-P-5f; Polish, Metal, Liquid; 1 August, 1944.

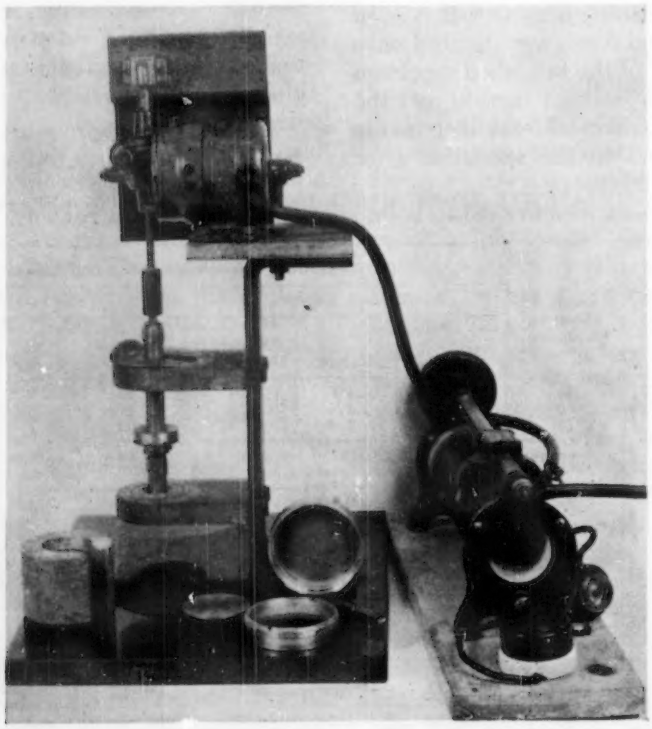

Fig. 3.—Abrasion Tester, Disassembled. Shaft supported by clip; polish cup, with cloth-retaining ring removed, at right; abrasion disk inverted at center, in front of billiard-cloth circle; slotted weight at left.

Abrasion Test

Other tests required to fix the quality and character of metal polishes include an abrasion test, a caking test, and tests for flammability, poisonous constituents, and reaction. The apparatus and procedure for measurement of abrasiveness of polishes prescribed in the former specification appeared to be satisfactory for that purpose except that the abrasion tester transferred to the Station from another laboratory was poorly constructed and yielded variable results. A similar machine was constructed at the Station to correct these mechanical discrepancies. This machine consists of a weighted vertical shaft with a recessed lower end to accept the shaft of a 2-in. diameter abrasion disk which rotates in contact with the bottom of the polish cup. The top of the shaft is attached to a rheostat-controlled gear-motor and is equipped with a revolution counter. The polish cup contains an internal screw-ring for holding the billiard cloth disk in place. There is a clip for supporting the shaft while the polish cup is being placed in position and the shaft weight is slotted so that it can be replaced for abrasion tests of other materials which require more or less shaft weight. This apparatus is illustrated in Figs. 3 and 4.

Development of a suitable abrasion test consisted of making numerous replicate determinations with each of the polishes used in the development of the polishing procedure and selecting a limit which separated good polishes from those which were obviously inferior. A shaft weight of 4 lb. and a test period of 500 rotations at 60 rpm. were used in this comparison study and were found to be acceptable. The polishes which performed satisfactorily in the tarnish-removal and polishing test usually yielded low abrasive numbers. The abrasive number represents the milligrams of weight lost by the disk during the test. This is due to the fact that abrasive polishes tend to produce a satin finish and thus prevent the development of a high gloss. The reproducibility of the test is illustrated by the data from tests of two representative polishes which are summarized in Table III.

Other Tests

Resistance to caking is an important characteristic of Naval polishes which frequently are stored in depots or aboard ship for relatively long periods of time. Caking tendencies were studied using a low-speed centrifuge of 9-in. radius designed to accommodate 75-ml. sample bottles $1\frac{1}{2}$ in. in diameter. Development of a mechanical caking test consisted of determining the time of centrifugation which would yield a persistent cake. Evaluations were made by placing 40-ml. samples of polish in the 75-ml. bottle, centrifuging them at various speeds and for various periods, and noting the results. The persistency of the cake was determined by noting the number of gentle inversions necessary to free the cake from the bottom of the bottle at the end of the test. It was found that centrifuging for 1 min. at 320 rpm. yielded caking numbers of the proper order. A caking number of 15 (15 inversions) was selected as the maximum allowable for acceptable polish.

In view of the superiority of water-base polishes indicated by the comparative studies conducted in this investigation and the desirability of such materials from a safety standpoint, an arbitrary flash-point minimum of 150 F. was included in the specification to guard against flammable polishes. Likewise a reaction test was prescribed to prevent the inclusion of acid constituents, which might etch the metal surface, and a qualitative test against cyanide, which might prove hazardous to the operator. These were selected as the hazardous constituents most likely to be included in metal polish.

Practicability of Methods

After more than a 4-yr. trial of this method of testing liquid metal polish, it can be concluded that it yields quantitative, numerical, reproducible measurements of all essential properties of such materials. The time required for such tests is less than that required by the previous method of manual polishing and visual evaluation, and the use of a standard reference polish has been eliminated. The importance of this elimination is illustrated by the fact that the former reference polish was the *only* one of eight used in the development work which failed to meet *every* performance requirement selected for the specification.

TABLE III.—REPRODUCIBILITY OF ABRASIVE NUMBER DETERMINATION SUMMARY OF EIGHT DETERMINATIONS EACH ON TWO METAL POLISHES.

	Polish E	Polish F
Maximum value	18.5	19.4
Minimum value	13.5	14.4
Mean value	15.65	16.50
Standard deviation	1.70	1.62

TABLE IV.—UNIFORMITY OF REFLECTANCE OF PREPOLISHED AND TARNISHED SILVER SPECIMENS—SUMMARY OF RESULTS ON 25 SPECIMENS; READINGS ALONG TWO AXES OF EACH.

Condition of Specimen Surface	Angle of Incident Light, deg.	Reflectance, Percentage of Incident Light		
		Mean	Range	Standard Deviation
Prepolished	45	83.15	8.5	2.69
Prepolished	60	84.42	10.7	2.62
Prepolished	75	85.74	7.6	2.03
Tarnished	45	7.36	4.55	1.01
Tarnished	60	7.64	4.55	1.22
Tarnished	75	10.98	4.5	1.36

Evaluation of Silver Polishes

The generally satisfactory character of the objective metal polish test prompted the development of a similar method for evaluating silver polishes. The existing specification[6] for silver polishes was even worse than that for metal polish in that no reference polish was employed and evaluations were based entirely on the judgment of the operator. Briefly, the former test consisted simply of tarnishing a silver crucible with ammonium sulfide solution, hand polishing it with the material under investigation, and then expressing an opinion as to the suitability of the product for Naval use. The limitations of such a system are obvious.

Development of Test Procedures:

Since the polish test apparatus (polish machine and abrasion tester) and general polishing procedures employed in testing liquid metal polish proved to be adaptable to the testing of silver polishes, it was necessary only to select suitable test specimens and operating periods and to develop a satisfactory method of tarnishing the test silver. Cold-rolled sterling silver was tried and proved to be satisfactory for both the polish specimens and the abrasion disks. Various tarnishing pro-

[6] Federal Specification P-P-571b; Polish, Silver; 4 April, 1939.

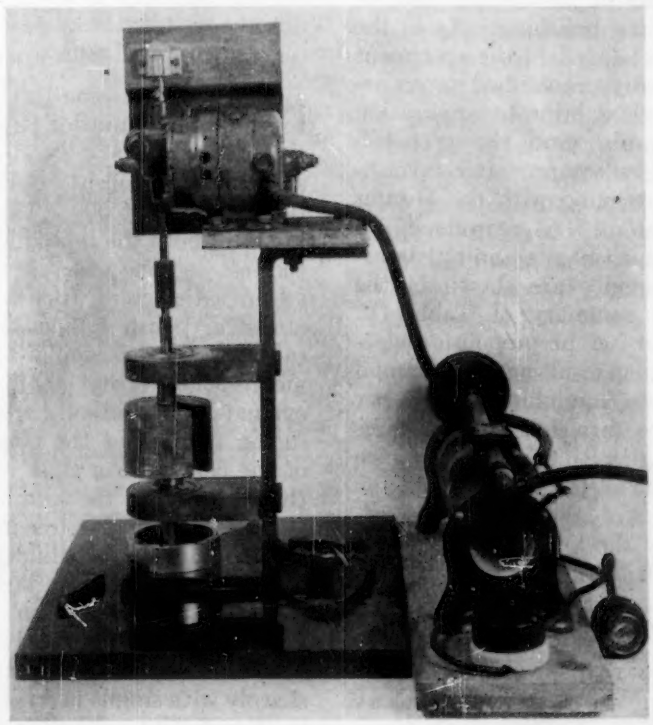

Fig. 4.—Abrasion Tester, Assembled. Key for tightening cloth-retaining ring at left; locking clip for shaft at right.

TABLE V.—COMPARATIVE PERFORMANCE OF FOUR SILVER POLISHES—SUMMARY OF RESULTS USING FOUR SPECIMENS WITH EACH POLISH.

Silver Polish	Angle of Incident Light, deg.	Reflectance, Percentage of Incident Light					
		Tarnish Removal			Final Gloss		
		Mean	Range	Standard Deviation	Mean	Range	Standard Deviation
G (liquid)	45	67.43	7.0	2.36	72.39	6.5	2.00
	60	69.65	6.0	1.74	72.93	5.5	1.56
	75	73.53	7.6	2.30	78.09	6.2	2.12
	Average	70.20	(86.0 per cent restoration)		74.47	(91.4 per cent restoration)	
H (liquid)	45	60.70	12.0	4.49	76.51	6.9	2.97
	60	63.26	10.9	3.15	78.11	6.4	2.34
	75	69.45	8.4	2.80	80.83	6.6	2.09
	Average	64.47	(75.8 per cent restoration)		78.48	(92.2 per cent restoration)	
I (paste)	45	24.36	2.4	0.83	67.20	8.8	2.67
	60	25.61	2.1	0.67	68.78	9.4	2.59
	75	30.94	3.2	1.01	73.13	9.7	2.94
	Average	26.97	(33.5 per cent restoration)		69.70	(84.0 per cent restoration)	
J (paste)	45	22.81	7.1	2.63	68.71	3.5	1.07
	60	23.69	8.7	2.98	70.04	5.8	1.61
	75	32.28	7.1	2.40	73.89	6.5	2.09
	Average	26.26	(31.2 per cent restoration)		70.88	(83.6 per cent restoration)	

cedures, including immersion in ammonium sulfide and hydrogen sulfide solutions and fuming with these reagents were tried and discarded before an acceptable procedure was discovered. The acceptable procedure consists of immersing the specimen in a 20 per cent solution of potassium sulfide maintained at 100 F with a constant temperature bath. The method yields a uniform, reproducible, dull-black tarnish which disappears uniformly and at the proper rate of speed during polishing. As in the test of metal polish, the specimens are manually prepolished to an acceptable gloss prior to application of the tarnish and the prepolish gloss and reflectance after tarnishing are measured with the Hunter reflectometer. The reproducibility of the prepolish gloss and the tarnish reflectance are shown in the statistical summary of Table IV. The dispersion in prepolish reflectances is that resulting from manual polishing to a minimum of 80 per cent. The tarnished silver retains sufficient gloss to permit reflectance readings at all three angles and the uniformity of the tarnish is evidenced by the low standard deviation of 1.01 to 1.36 per cent.

TABLE VI.—REPRODUCIBILITY OF ABRASIVE NUMBER DETERMINATION SUMMARY OF EIGHT DETERMINATIONS EACH ON TWO SILVER POLISHES.

	Polish H	Polish K
Maximum value	59.0	7.9
Minimum value	51.0	5.5
Mean value	54.71	6.63
Standard deviation	4.88	0.78

The same polishing procedure for measurement of tarnish removal and final gloss as was used for metal polish could be adopted directly for evaluation of silver polish: reflectance after 4 min. for tarnish removal and after 10 min. for final gloss. Data from quadruplicate tests on four representative polishes are summarized in Table V. Although silver has a higher reflectivity than brass, the specification limits, expressed as required percentage restoration of original gloss, are almost identical.

Abrasion Test:

The silver abrasion test is similar to the brass abrasion test except that it employs a sterling silver specimen and consists of 2000 rotations instead of 500. Table VI illustrates both the reproducibility of the test and the wide difference between satisfactory (polish K) and abrasive (polish H) polishes. The caking test also is similar to that for metal polish except that caking is evaluated qualitatively after centrifuging by testing the compactness of the cake with a glass rod rather than by noting the number of inversions necessary to free it from the bottom of the container. This change was necessary, because the semicolloidal compaction obtained on centrifuging liquid silver polish does not separate and redisperse sharply with simple inversion. Tests for flammability, reaction, and cyanide are identical with those for metal polish.

TABLE VII.—COMPARATIVE PERFORMANCE OF VARIOUS TYPES OF SILVER POLISH.

Silver Polish		Restoration of Prepolish Gloss, per cent	
Designation	Type	Tarnish Removal (4 min.)	Final (10 min.)
G	Liquid	86.4	91.8
H	Liquid	75.0	92.9
K	Liquid	73.2	94.9
L	Paste	78.9	87.6
M	Paste	49.9	55.3
N	Paste	18.8	33.7
O	Powder	38.1	65.6

Discrimination of Developed Procedures:

In addition to providing limits for an improved specification[7] the comparative testing of silver polishes provided an interesting study of the relative merits of liquid, paste, and powder products. Representative data for the three types are tabulated in Table VII. Contrary to the belief of the average user, the paste and powder types proved to be markedly inferior to the liquid variety. One paste, polish L, approached the efficiency of the liquid, polish G, from the same manufacturer. The inferior powder, polish O, is the product of the manufacturer of the excellent liquid, Polish K. This misconception concerning silver polishes serves to illustrate the inadequacy of the previous method of test and increases the desirability of a mechanical test and instrumental evaluation such as that described in this paper.

Conclusions

Whenever a consumer writes a purchase specification it is preferable for him to define the standard of product-performance satisfactory for his needs rather than to prescribe the formula by which he hopes a satisfactory product can be made. By the latter method the user binds himself to a material which, however satisfactory at the moment, is not subject to the improvement which an informed and enterprising manufacturer continuously makes in his product. The Navy favors and encourages the development of the performance type of specification. By the adoption of the testing methods described in this paper, specification of performance has been extended into a new field with resulting economy and clarification of standards of suitability.

[7] Bureau of Ships ad Interim Specification 51-P-28 (INT); Polish, Silver, Liquid; 1 March, 1944.

Conducting Paint Electrodes for Dielectric Measurements

By E. Gerald Meyer[1] and Myron A. Elliott[2]

THE first attempts made to use colloidal silver paint as conducting electrodes for measuring dielectric materials in this laboratory were not too successful. The silver paste, as originally obtained, was rather thick for spraying or painting and dried too slowly. There is danger of some electrical insulating materials (especially films) being attacked by the solvent and binder in the paste during the drying process. An attempt was made to use a prepared commercial silver paint that was suitable for spraying, but, probably due to changes during shipping and storage, the electrodes formed with this material had practically no conductivity. A satisfactory silver paint was then prepared in the following manner using available commercial materials.

Experimental

The basic material used in this paint is Silver Paste No. 4133 manufactured by the Electrochemicals Dept. of the E. I. du Pont de Nemours and Co., Perth Amboy, N. J. Thirty grams of the above paste are mixed well with 20 ml. of dry acetone and the mixture centrifuged at 2000 rpm. for 15 min. The supernatant liquid is then decanted and, without disturbing the precipitate in the bottom, the centrifuge tube is washed with two additional portions of acetone. Twenty milliliters of absolute alcohol are now added to the precipitate (colloidal silver with remaining binder) and the materials stirred together well. The spray is now ready for use. It can be kept indefinitely in airtight bottles, but it must be shaken thoroughly before each application.

The following conditions were determined as most favorable for producing sprayed electrodes: The colloidal silver mixture is sprayed with an artists' air brush using dried air at a line pressure of 30 psi. and holding the nozzle of the air brush 12 to 15 cm. from the target. A spraying time of about 5 sec. per square centimeter of area to be covered gives a good surface, providing the air brush is handled so that the target is uniformly covered. The dry electrodes should have a thickness of at least 0.001 in.

While spraying the colloidal silver mixture, it is desirable to evaporate the alcohol solvent as soon as the spray hits the target. This is done to minimize any reaction between the spray and the dielectric and also to prevent the silver from "running" after it is on the target. Drying is accomplished by installing an ordinary electric hair dryer about 10 cm. from the target and aiming the air stream so that it strikes the lower half of the target at a slightly upward angle. It is necessary, however, to be sure that the spray hits the target in the liquid state. If the sprays drys before it hits, then the resulting coatings will be very soft and unsatisfactory. Another important point is to make sure that no water gets into the spray either by condensation from the atmosphere during the spraying operation or by absorption or other means before the spraying operation. If it is desired to increase the permanency of the electrode, this can be done by placing the sample sprayed side down, on a hot plate at about 70 C. for 10 to 15 min. immediately after spraying.

All samples for the electrical tests were conditioned at 50 per cent relative humidity and 25 C. Polystyrene disks were used in all tests, unless otherwise noted, because the low loss of polystyrene makes it easier to detect small losses in the electrode itself.

Foil electrodes were applied with petrolatum, and zinc-sprayed metal electrodes were applied with a wire feed metallizing gun.

Discussion

The undiluted silver paste No. 4133, as received from the manufacturer, will give a higher conductivity when thoroughly dried than the spray preparation described in this paper. The conductivity of the spray preparation, however, was found to be entirely adequate when properly applied. The spray has the advantage of being inert to practically all insulating materials and being readily adapted to mass production methods where a large number of specimens are to be coated. Guard rings may be applied by the use of a suitable mask. If it is certain that the insulating material being measured (phenolics, for example) is not attacked in any way by the original silver paste, then a sprayable mixture can be prepared by simply thinning the original to the desired consistency with a small amount of absolute alcohol. This mixture will not dry nearly so rapidly as the one prepared by the removal of some of the binder in the original paste, but it will have good conductivity when the dried film is built up to a thickness of the order of 0.001 in.

Any attack that might be caused by the silver spray mixture would be the result of the solubility effect of the alcohol present. Thus, materials which are little affected by alcohol could not be attacked because the alcohol is evaporated from the test surface almost instantaneously.

Figure 1 shows silver spray electrodes applied to a variety of surface types. Although this silver paint can be applied most uniformly by spraying, it can also be satisfactorily applied by painting on with a small brush.

Table I shows that the d-c. resistance of properly applied sprayed silver electrodes is low. While it is not so low as that of metal foil electrodes, it is much less than that of Aquadag and is satisfactory for general use.

Table II shows loss values obtained at 1, 10, and 30 megacycles,

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[1] Research and Development Division, New Mexico School of Mines, Albuquerque, N. Mex. (formerly with Naval Research Laboratory, Washington, D. C.)

[2] Consultant (Dielectrics), Chemistry Division, Naval Research Laboratory, Anacostia Station, Washington, D. C.

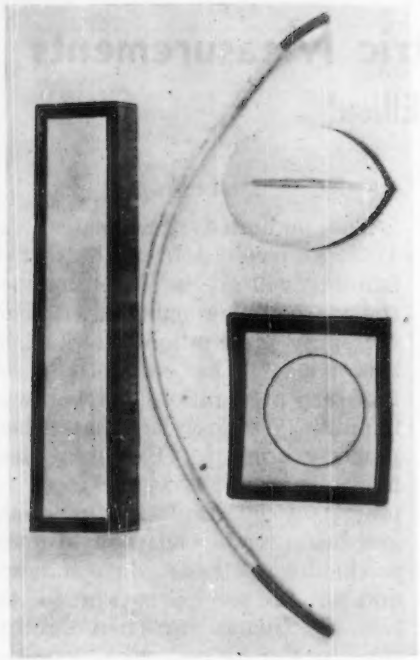

Fig. 1.—Silver Spray Electrodes Applied to a Variety of Surface Types.

TABLE I.—RESISTIVITY OF VARIOUS ELECTRODE MATERIALS AT 25 C.

Material	Volume Resistivity, micro-ohm per centimeter	Resistance per Square for 0.002-in. Layer, ohms
Tinfoil	12.9	0.00253
Silver paste, du Pont No. 4133[a]	350	0.068
Silver paint—sprayed	856	0.17
Aquadag	196 000	39.

[a] Lot 15002. Film cast on glass and dried 24 hr. at 50 C. Final thickness was 0.0014 in. The paste was 8 months old, but otherwise used as received from manufacturer.

respectively, with sprayed silver electrodes and with various other types of electrodes. These data were obtained with a Twin-T Impedance Measuring Circuit Type 821-A (for 1 and 10 megacycles)[3] and with a susceptance variation circuit developed at the Naval Research Laboratory (for 30 megacycles). The change-of-voltage procedure was used with the susceptance variation circuit.[4] The dissipation factor of polystyrene at 1 and 10 megacycles could not be detected with the Twin-T circuit and thus is less than 10^{-3} for all electrodes.

The column headed "Backing" in Table II refers to the manner in which the specimen was placed in the measuring circuit. All specimens were 2 in. in diameter and $\frac{1}{8}$ in. thick. Those indicated to have a backing of brass were fully inserted between 2-in. diameter brass disks during the measurement. Those indicated to have no backing were measured by contacting the specimen electrodes near one edge by brass disks less than 0.5 in. in diameter. Dielectric constant values are not given for specimens measured at 30 megacycles with no backing because of the difficulty of making edge and inductance corrections.

The $\frac{1}{8}$-in. thick, 2-in. diameter specimen was chosen for this work since it was the size being used at the time in other work here and it was also the most suitable for use with the susceptance variation circuit at 30 megacycles.[5] Thinner specimens of higher dielectric constant would have given a more sensitive test of the electrode material used, but that is beyond the scope of the present paper. The object here is to report the results of the practical application of electrodes to some electrically stable organic insulating materials encountered in the normal course of work.

Since the electrode material is an adhering paint, there can be no question about the closeness of contact between the electrode and specimen. The important questions are: first, whether there is any chemical or solvent action between the undried paint and the specimen surface and, second, whether the series resistance of the electrode is so high that errors are introduced at the higher frequencies. Aquadag, with its relatively high resistance, has been successfully used for many years at audio frequencies, so the silver paint, except for its possible solvent action, should certainly be satisfactory at the low frequencies. The measurements reported in this work are, therefore, in the higher frequency range as that is where difficulty with the silver paint electrodes is most likely to occur.

The results given in Table II show that within the experimental errors of the methods used the sprayed silver gave the same results as metal foil electrodes except at 30 megacycles, where, without metal backing, the use of sprayed silver electrodes caused the dissipation factor of polystyrene to be doubled. The fact that polystyrene measured with either tinfoil or metallized zinc electrodes unbacked by brass disks appeared to show a lower loss by approximately 0.0001 than when backed is very probably due to experimental error. It is probable that for thinner and larger diameter specimens or for materials of higher dielectric constant difficulty would also have been experienced at 10 megacycles. It is recommended, therefore, that sprayed silver electrodes not be used at frequencies of 10 megacycles or above without proper backing with metal foil or other high conducting material.

TABLE II.—ELECTRICAL MEASUREMENTS MADE ON POLYSTYRENE USING VARIOUS ELECTRODES

Electrode	Frequency, megacycles	Backing	Dielectric Constant	Dissipation Factor
Tinfoil	1[a]	None	2.55	0.000
Metallized zinc	1[a]	None	2.58	0.000
Sprayed silver	1[a]	None	2.59	0.000
Tinfoil	10[a]	None	2.54	0.000
Metallized zinc	10[a]	None	2.56	0.000
Sprayed silver	10[a]	None	2.56	0.000
Tinfoil	30[b]	None	...	0.00043
Metallized zinc	30[b]	None	...	0.00041
Sprayed silver	30[b]	None	...	0.00080
Tinfoil	30[b]	Brass	2.55	0.00049
Metallized zinc	30[b]	Brass	2.59	0.00053
Sprayed silver	30[b]	Brass	2.57	0.00049

[a] Measurements made with Twin-T Impedance Measuring Circuit.
[b] Measurements made with Susceptance Variation Circuit.

Summary

Various types of conducting materials including tinfoil, metallized zinc, and conducting silver paint were compared as electrode materials for dielectric constant and power factor measurements on polystyrene. A convenient method of preparing and applying the conducting paint as a quick-drying spray is described, whereby there is practically no danger of damaging the surface of the specimen with the wet paint.

The sprayed conducting paint electrodes were found to be the most convenient to use of the group tried. All the electrodes gave the same electrical results within the experimental errors of the methods used except unbacked sprayed silver paint at 30 megacycles. It was recommended that silver paint electrodes be backed with metal foil for use at frequencies of 10 megacycles or above.

[3] D. B. Sinclair, *Proceedings*, Inst. Radio Engrs., Vol. 28, pp. 310-318 (1940).

[4] Tentative Methods of Test for Power Factor and Dielectric Constant, (D 150 - 45 T), 1945 Supplement to Book of A.S.T.M. Standards, Part III, p. 275. (See Section 23 *c*.)

[5] *Ibid.*, Section 11 (*a*).

Influence of Nonhomogeneity of Wood on Its Strength Properties*

By E. George Stern[1]

Synopsis

The influence of variation in nonhomogeneity, as expressed by variation in specific gravity, within clear wood specimens originating from a stick, plank, bolt, tree, and species on the strength properties of and design data for wood are discussed and illustrated. Consideration of these variations may lead to significant observations. Disregard of these variations may result in misleading test information not truly representative for the material, thus leading to unsatisfactory design data.

Wood is a nonhomogeneous structural material of varying fiber and cell structure containing sapwood and heartwood, springwood and summerwood, varying density and growth rates, and a variety of growth irregularities, such as cross-, spiral-, and interlocked-grain, knots, pitch pockets, shakes, checks, compression wood, mineral streaks, and wanes. For establishing safe working stresses for the numerous wood species and computing the strength of wood members, tests have been performed on small clear representative specimens free from any growth irregularities and deficiencies, and on full-size timbers and timber structures. Variations in sapwood, heartwood, springwood, summerwood, density, and growth rates within the small clear A.S.T.M. standard test specimens used for the determination of properties representative of the respective wood species (A.S.T.M. Designation: D 143–27)[2] are of influence on the test data. These variations are characteristic for the nonhomogeneous material. Within given specified limits, they are accepted in design with wood. General correlations of the physical properties of wood with its mechanical properties were established and are given full consideration by those engineers familiar with the characteristics of wood as an engineering material.

It is the purpose of this paper (1) to indicate the influence of variation in nonhomogeneity, as expressed by variation in specific gravity, within clear specimens originating from a stick, a plank, a bolt, a tree, and a species on the strength properties of and design data for wood, and (2) to show that disregard of these variations may result in misleading test information not truly representative for the material under consideration.

All test data, except those taken from publications of the U. S. Forest Products Laboratory, were obtained in the Virginia Polytechnic Inst. Wood Research Laboratory under the auspices of the V.P.I. Research Foundation, Inc. Gratitude is expressed to Phyllis L. Thrasher, laboratory assistant, for her assistance during the performance of the tests.

Extent of Nonhomogeneity as Expressed by Variation in Specific Gravity Within a Stick, Plank, Bolt, Tree, and Species

The appearance of wood is a fair indication for many of its properties and characteristics. For specimens of similar appearance, however, the specific gravity may vary considerably. This is not surprising when consideration is given to such variables affecting tree growth, as soil, growing space, available moisture, predominant temperature, and humidity. But even if such influences on the growth are somewhat eliminated from affecting test data by selecting representative samples from a selected tree, certain variations can be recorded in data on the specific gravity of test specimens. These variations may only be slight, possibly negligible and insignificant in light of such variations as may be found for wood from near the pith, from heartwood or from sapwood and from different trees of the same species.

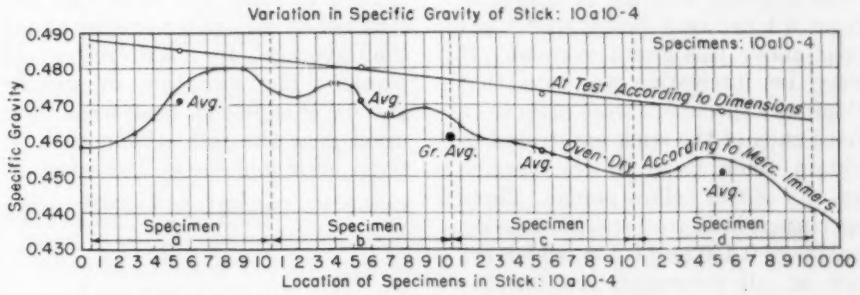
Variation in Specific Gravity of Stick: 10a10-4
Specimens: 10a10-4
At Test According to Dimensions
Oven-Dry According to Merc. Immers.
Avg.
Gr. Avg.
Specific Gravity
0.490
0.480
0.470
0.460
0.450
0.440
0.430
Specimen a
Specimen b
Specimen c
Specimen d
0 1 2 3 4 5 6 7 8 9 10 1 2 3 4 5 6 7 8 9 10 1 2 3 4 5 6 7 8 9 10 1 2 3 4 5 6 7 8 9 10 0 0
Location of Specimens in Stick: 10a10-4

Fig. 1.—Variation in Specific Gravity Within Clear Planed and Sanded Yellow Poplar Stick of 3-ft. Length and 2 by 2 in. in Section.

To determine the extent of variation in nonhomogeneity in a single clear planed and sanded yellow-poplar *stick* of uniform appearance, of 3-ft. length and 2 by 2-in. section, specific gravity determinations were made on 43 oven-dry $\frac{3}{4}$ by 2 by 2-in. specimens sawn from this stick and sanded along the saw cuts. The specific gravity determinations were made according to the mercury-

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[1] Associate Research Professor, Department of Wood Construction, and Director, Wood Research Laboratory, Virginia Polytechnic Inst., Blacksburg, Va.

[2] Standard Methods of Testing Small Clear Specimens of Timber (D 143–27), 1946 Book of A.S.T.M Standards, Part II, p. 774.

TABLE I.—VARIATION IN SPECIFIC GRAVITY WITHIN EACH OF FOUR CLEAR PLANED AND SANDED YELLOW POPLAR *PLANKS* OF 2½ TO 3-FT. LENGTHS, 2-FT. WIDTH, AND 2-IN. THICKNESS.

Origin of Plank	Sign of Plank	Number of Tests	Test Values			Variation from Average Values, per cent	
			Min.	Max.	Average	Min.	Max.
Lower bolt	8a4	25	0.39	0.51	0.429	−9.1	+18.9
Lower bolt	8a5	22	0.39	0.46	0.424	−8.0	+8.5
Lower bolt	8a4 & 5	47	0.39	0.51	0.427	−8.7	+19.4
Upper bolt	8c4	20	0.37	0.46	0.424	−12.7	+8.5
Upper bolt	8c5	17	0.40	0.47	0.434	−7.8	+8.3
Upper bolt	8c4 & 5	37	0.37	0.47	0.429	−13.8	+9.6

immersion method (1)[3] after performance of compression-parallel-to-grain tests on the central part of the stick. The variation in specific gravity within the stick, as shown in Fig. 1, ranged from 0.436 to 0.480, with a grand average of 0.461, or from 5.4 per cent below to 4.1 per cent above this grand average. It may be interesting to note that originally specimens were sawn from both ends of the stick and tested to obtain some data on the specific gravity of this yellow poplar. These specimens indicated specific gravity values of 0.436 and 0.458, which are not at all representative for the whole stick, as illustrated in Fig. 1.

The variation in specific gravity within a *plank* was obtained for each of four approximately 2½ to 3-ft. long, 2-ft. wide and 2-in. thick clear straight-grained planks from a tree of the same origin (2) as the above stick. Two of the planks had adjacent origin in a lower bolt and the other two planks in an upper bolt from this tree. They contained sapwood, heartwood, and wood near the pith. The specific gravity was observed for 84 oven-dry ¾ by 2 by 2-in. specimens (3) tested according to the water-immersion method (1). The specific gravity values for these planks ranged as indicated in Table I and showed extreme values of 12.7 per cent below and 18.9 per cent above the average for the respective planks. The variation in specific gravity of sapwood, heartwood, and wood near the pith within each of these four planks is indicated in Table II. The respective extreme specific gravity values observed for sapwood, heartwood, and wood near the pith were found to be 5.7, 8.7, and 12.7 per cent below and 8.5, 18.9, and 1.4 per cent above the averages for the respective plank. These extreme test values for variation in the specific gravity within a plank are based on tests relatively limited in number, particularly if comparison is made with the significant variations in specific gravity within a single stick. Hence, the observed extreme values for specific gravity within the planks may be less extreme than those which might have been observed if all sections of the planks had been tested. Thus, these data may be considered conservative for the yellow poplar planks under observation.

The variation in specific gravity within a *bolt* is shown for one 2½-ft. and one 3-ft. long, 27-in. diameter clear straight-grained yellow-poplar bolt (2) from which the four above-described planks were sawn. The specific gravity data were obtained for 256 specimens taken from sapwood, heartwood, and wood near the pith sawn from the bolts at random simultaneously with those for the above-described planks (3). The range for these data, as given in Table III, indicates that the extreme values were 14.7 per cent below and 20.9 per cent above the average for the respective bolts. The variation in specific gravity of sapwood, heartwood, and wood near the pith within each of the two bolts is indicated in Table IV. The respective extreme specific gravity

TABLE II.—VARIATION IN SPECIFIC GRAVITY OF SAPWOOD, HEARTWOOD, AND WOOD NEAR THE PITH WITHIN EACH OF FOUR CLEAR PLANED AND SANDED YELLOW POPLAR *PLANKS* OF 2½ TO 3-FT. LENGTHS, 2-FT. WIDTH, AND 2-IN. THICKNESS.

Origin of Plank	Sign of Plank	Test Values						Variation from Average Values for Planks, per cent					
		Sapwood		Heartwood		Wood Near Pith		Sapwood		Heartwood		Wood Near Pith	
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Lower bolt	8a4	0.43	0.45	0.40	0.51	0.39	0.43	+0.2	+4.9	−6.8	+18.9	− 9.1	+0.2
Lower bolt	8a5	0.43	0.46	0.41	0.46	0.39	0.43	+1.4	+8.5	−3.3	+ 8.5	− 8.0	+1.4
Lower bolt	8a4 & 5	0.43	0.46	0.40	0.51	0.39	0.43	+0.7	+7.7	−6.3	+19.4	− 8.7	+0.7
Upper bolt	8c4	0.40	0.45	0.39	0.46	0.37	0.42	−5.7	+6.1	−8.7	+ 8.5	−12.7	−1.0
Upper bolt	8c5	0.46	0.47	0.40	0.47	0.40	0.43	+6.0	+8.3	−7.8	+ 8.3	− 7.8	−0.9
Upper bolt	8c4 & 5	0.40	0.47	0.39	0.47	0.37	0.43	−6.8	+9.6	−9.1	+ 9.6	−13.8	+0.2

TABLE III.—VARIATION IN SPECIFIC GRAVITY WITHIN EACH OF TWO YELLOW POPLAR *BOLTS* OF 2½ TO 3-FT. LENGTHS AND 27-IN. DIAMETER.

Origin of Bolt	Sign of Bolt	Number of Tests	Test Values			Variation from Average Values, per cent	
			Min.	Max.	Average	Min.	Max.
Lower position	8a	120	0.38	0.52	0.430	−11.6	+20.9
Upper position	8c	136	0.37	0.48	0.434	−14.7	+10.6
Lower and upper position	8a & c	256	0.37	0.52	0.432	−14.4	+20.4

TABLE IV.—VARIATION IN SPECIFIC GRAVITY OF SAPWOOD, HEARTWOOD, AND WOOD NEAR THE PITH WITHIN EACH OF TWO YELLOW POPLAR *BOLTS* OF 2½ TO 3-FT. LENGTHS AND 27-IN. DIAMETER.

Origin of Bolt	Sign of Bolt	Test Values						Variation from Average Values for Bolts, per cent					
		Sapwood		Heartwood		Wood Near Pith		Sapwood		Heartwood		Wood Near Pith	
		Min.	Max.	Min.	Max.	Min.	Max.	Min	Max.	Min.	Max.	Min.	Max.
Lower position	8a	0.38	0.49	0.38	0.52	0.39	0.43	−11.6	+14.0	−11.6	+20.9	− 9.3	0.0
Upper position	8c	0.40	0.48	0.37	0.48	0.37	0.43	−7.8	+10.6	−14.7	+10.6	−14.7	−0.9
Lower and upper position	8a & c	0.38	0.49	0.37	0.52	0.37	0.43	−12.0	+13.4	−14.4	+20.4	−14.4	−0.5

[3] The boldface numbers in parentheses refer to the references appended to this paper.

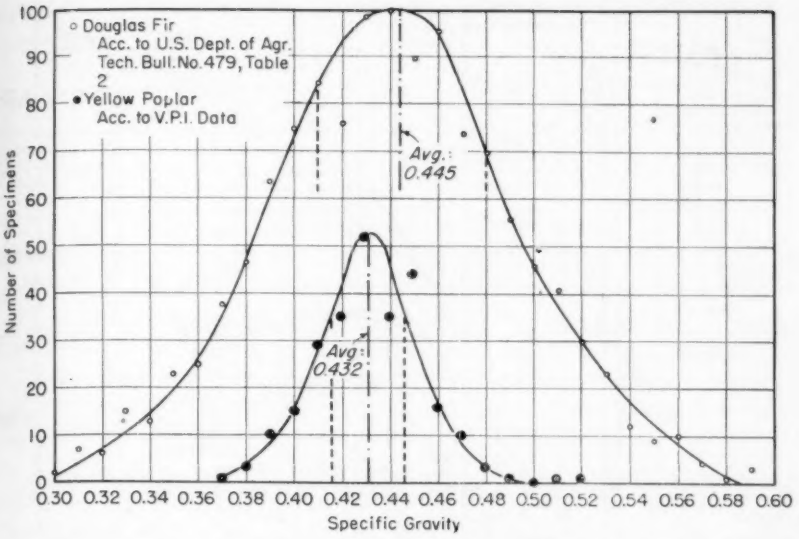

Douglas Fir
Acc. to U.S. Dept. of Agr.
Tech. Bull. No. 479, Table
2
Yellow Poplar
Acc. to V.P.I. Data
Avg.
0.445
Avg.
0.432
Number of Specimens
Specific Gravity
0 10 20 30 40 50 60 70 80 90 100
0.30 0.32 0.34 0.36 0.38 0.40 0.42 0.44 0.46 0.48 0.50 0.52 0.54 0.56 0.58 0.60

Fig. 2.—Frequency Distribution for 256 Specific Gravity Values Obtained for Specimens from Two Bolts of a 12-ft. Long Yellow Poplar Tree Trunk of 27-in. Diameter and for 1240 Specific Gravity Values Obtained for Specimens from More than 30 Douglas Fir Trees.

values observed for sapwood, heartwood, and wood near the pith were found to be 11.6, 14.7, and 14.7 per cent below and 14.0, 20.9, and 0.0 per cent above the averages for the respective bolt.

Since one of these bolts was sawn from the lower and one from the upper part of the yellow-poplar *tree* (2), the variation in specific gravity within the tree trunk of 12-ft. length is also presented in Table III. The extreme specific gravity values were found to be 14.4 per cent below and 20.4 per cent above the observed average for this tree trunk. Table IV indicates that the respective extreme specific gravity values observed for sapwood, heartwood, and wood near the pith were 12.0, 14.4, and 14.4 per cent below and 13.4 and 20.4 per cent above and 0.5 per cent below the averages for this tree. The frequency distribution for the 256 specific gravity values for this tree trunk is given in Fig. 2, which indicates that one half of the specific gravity values obtained are within ±3.5 per cent of the average specific gravity of 0.432 or within the limits of 0.417 and 0.447. Since these data were obtained for a relatively small number of small specimens from the two bolts, as compared with the possible number of samples, and since the variation in specific gravity within a single stick was found to be relatively large, a larger variation and a frequency distribution with a wider spread probably would have been observed if data had been obtained for a larger number of specimens.

The 250 specific gravity tests of yellow poplar from 96 boards obtained from seven mills in the Appalachian region, reported on by the Forest Products Laboratory (4) as representative for this *species*, indicated a specific gravity, based on oven-dry weight and volume, of 0.434 with minimum and maximum values of 0.29 and 0.55, respectively, that is, with minimum and maximum values 33.2 per cent below and 26.7 per cent above the average. The variation in specific gravity within a wood species was determined for coast-type Douglas fir (5). The data, based on weight when oven-dry and volume when green of 1240 clear specimens from more than 30 trees, indicate an average specific gravity of 0.445 with minimum and maximum values of 0.308 and of 0.594, respectively, that is, 30.8 per cent below and 33.5 per cent above the average value. The frequency distribution of these data, as shown in Fig. 2, indicates that a little more than one half of the specific gravity values for this species were within ±7.9 per cent of the average.

Frequency distributions of the specific gravity values indicate that most of the data are close to the average. The extremes in variation in specific gravity, however, may have to be given consideration in determining design data for wood. For this purpose, the above-given extreme test values are summarily presented in Table V.

Correlation of Specific Gravity with Strength Properties of Stick, Tree, Species, and Average of 163 Species

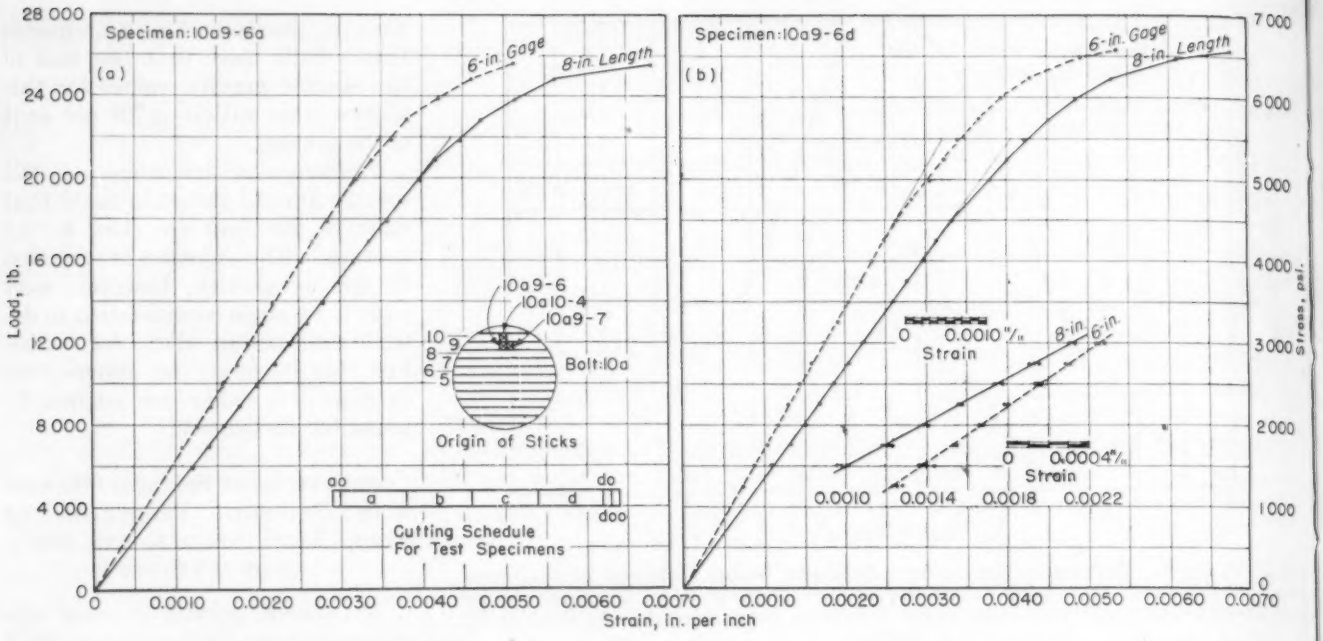
The specific gravity of wood substance is nearly the same for wood of all species. Hence, this physical property can be used as an index of the amount of wood substance present in a piece of wood. The strength properties of wood can be correlated with the amount of wood substance. Hence, the specific gravity of wood at a given moisture content can also be used as an index for the strength of a piece of wood.

In order to obtain data on the correlation of specific gravity with strength of a single *stick* of wood, compression-parallel-to-grain tests were performed on the clear straight-grained 2 by 2 in. in section 3-ft. long yellow-poplar stick of 7.1 per cent moisture content, the specific gravity of which is shown in Fig. 1. The four compression tests performed on standard specimens from this stick were run to the ultimate, after several repetitive test runs to a total load of 15,000 lb. had been completed. Previous preliminary tests run with single and repetitive loadings indicated, as shown in Fig. 3, that repetitive loadings within the elastic range yield practically identical test data, particularly since no

TABLE V.—VARIATION IN SPECIFIC GRAVITY WITHIN A *STICK, PLANK, BOLT, TREE* AND *SPECIES.*

Origin of Specimens	Number of Tests	Average Specific Gravity Oven-dry	Variation from Observed Average Values, per cent	
			Min.	Max.
1 Yellow poplar stick	43	0.461	−5.4	+4.1
4 Yellow poplar planks[a]	84	0.428	−12.7	+18.9
2 Yellow poplar bolts[a]	256	0.432	−14.7	+20.9
1 Yellow poplar tree[a]	256	0.432	−14.4	+20.4
Yellow poplar trees	250	0.434	−33.2	+26.7
Douglas fir trees	1240	0.445[b]	−30.8	+33.5

[a] Specimens from same tree.
[b] According to weight when oven-dry and volume when green.



(*a*) **Single test run to ultimate.**

(*b*) **Repetitive test runs to total load of 12,000 lb., followed by single test run to ultimate.**

Fig. 3.—Load-Deformation Diagram for Compression-Parallel-to-Grain Tests on Yellow Poplar.

residual plastic strain was observed for the respective test range. Hence, the repetitive loading procedure had no influence on the test data. Figure 4 gives the load-deformation diagrams for the tests on the matched specimens from the above-described stick. The average strain, including local strain at the specimen ends, is plotted for the total specimen length of 8 in., as indicated by a dial gage reading the total deformation in 0.0001 in., and for the gage lengths of 6, 5½, 5, 4½, and 4 in., as determined by a self-averaging compressometer (6) with adjustable gage length. The test data are given in Table VI. The variation in moduli of elasticity for the total specimen length and the various gage lengths is indicated in Table VII. These tabulated test data are plotted in Fig. 5, with the actual average specific gravity for the specimen length and respective gage lengths determined according to Fig. 1. The correlation of specific gravity of oven-dry specimens with compression-parallel-to-grain strength properties is evident and suggests a definite increase in strength with an increase in specific gravity. The correlation appears

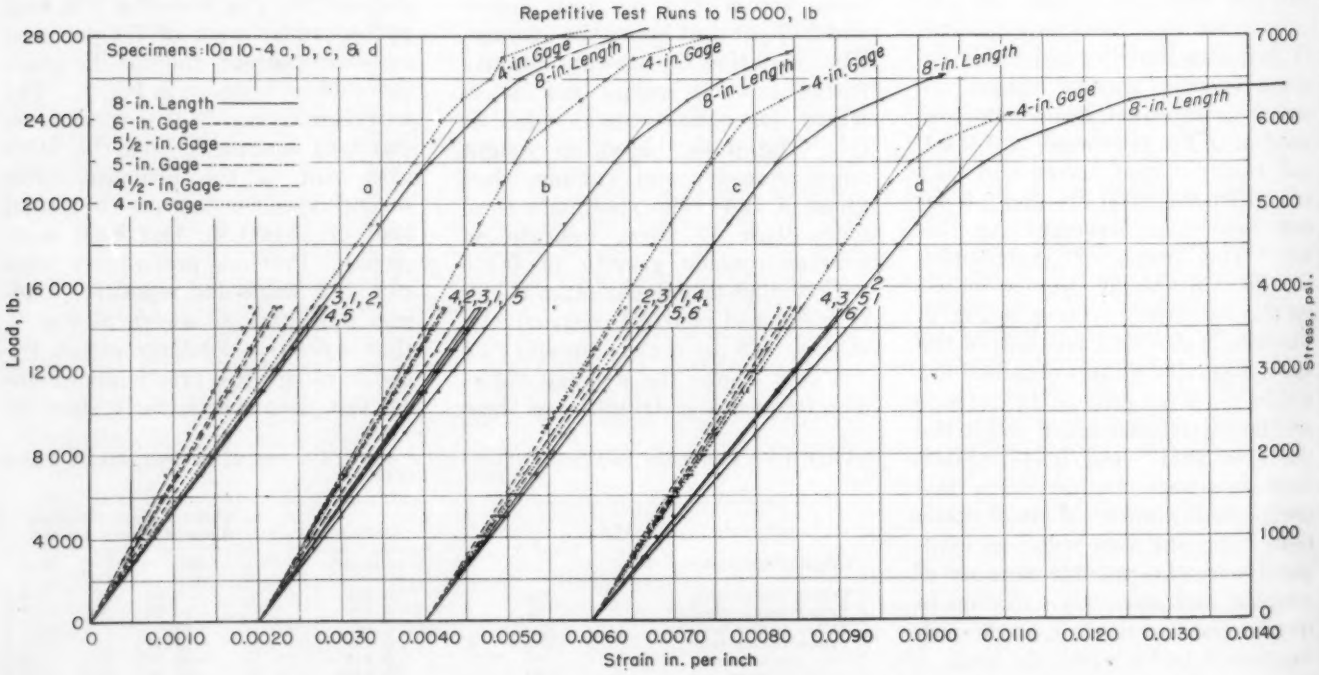


Fig. 4.—Load-Deformation Diagram for Compression-Parallel-to-Grain Tests on Yellow Poplar from 3-ft. Long Stick of Known Specific Gravity, Repetitive Test Runs to Total Load of 15,000 lb. Followed by Single Test Run to Ultimate.

TABLE VI.—COMPRESSION-PARALLEL-TO-GRAIN STRENGTH OF YELLOW POPLAR FROM 3-FT. LONG *STICK* OF KNOWN SPECIFIC GRAVITY.

Test Sign	Weight, in.	Cross-Section, sq. in.	Test Weight, g.	Oven-Dry Weight, g.	Moisture Content, per cent	Specific Gravity		Proportional Limit, psi.c	Ultimate Stress, psi.	Modulus of Elasticity, psi.c	Type of Failure
						Oven-dry[a]	At Test[b]				
10a10-4a0.....	..	..	17.58	16.41	7.13	0.458	...	..	..	.....	.....
10a10-4d0.....	..	..	14.64	13.65	7.25	0.439	...	..	..	.....	.....
10a10-4d00.....	..	..	13.73	12.83	7.01	0.436	...	..	..	.....	.....
10a10-4a.....	8.01	4.00	254.4	...	..	0.471	0.485	5250	7135	1 697 000	End shear
10a10-4b.....	8.02	4.03	254.1	...	..	0.471	0.480	5460	7060	1 525 000	Shear
10a10-4c.....	7.98	3.97	245.6	...	..	0.457	0.473	5290	6750	1 601 000	Shear
10a10-4d.....	7.95	3.98	242.8	...	..	0.451	0.468	5025	6465	1 584 000	End crush
Average,4a to 4d	7.99	4.00	249.2	...	..	0.462	0.477	5250	6850	1 602 000	Shear

[a] According to mercury-immersion method. [b] According to dimensions. [c] For standard gage length of 6 in.

to be rectilinear for the given specific gravity range and may be expressed as such. In order to pass through the zero point of origin, the rectilinear correlation may, according to

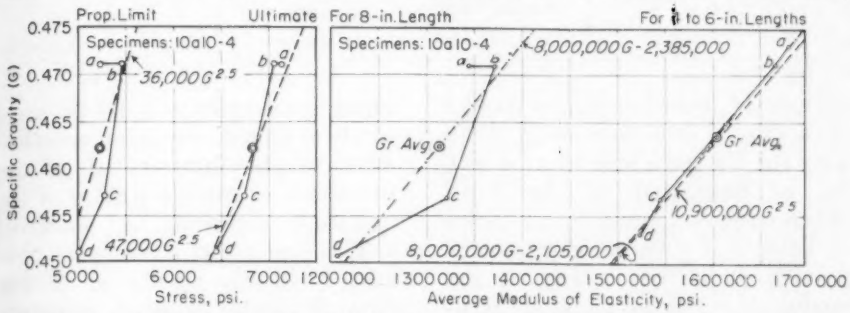


Fig. 5.—Correlation of Specific Gravity for Oven-Dry Specimens with Compression-Parallel-to-Grain Strength Properties for Yellow Poplar from Single Stick of 7.1 per cent Moisture Content.

Fig. 5, be expressed by the following curvilinear equations which appear rectilinear within the given specific gravity range:

Stress at proportional limit, psi.....
.....36 000 $G^{2.5}$
Stress at ultimate, psi.....47 000 $G^{2.5}$
Modulus of elasticity, psi.....
.....10 900 000 $G^{2.5}$

The correlation of specific gravity with strength properties of a *tree* was determined for the previously described yellow poplar tree with known variation in its specific gravity. According to diagrams showing strength data at 8.5 to 8.9 per cent moisture content plotted against specific gravity when oven-dry (2), the rectilinear or curvilinear averages for the test data show characteristic strength increases with specific gravity increases, similar to those found for the above-described stick. The relationship however, seems to be represented by a power of specific gravity which is lower than that for the single stick and which even is unity for certain strength properties. In testing a large number of specimens from a tree, the averages represent both the low and high individual test data. Thus, the given averages are neither extremely low nor extremely high, while individual test data, such as those for the single stick, may contain both low and high extremes. Thus, the larger the number of test data under consideration, the less extreme are the average strength values and the smaller should be the power of specific gravity in equations expressing the specific gravity and strength relationship. The correlating equations for strength in flexure, toughness value, and strength in compression, tension, and shear parallel to grain of wood from the yellow poplar tree are given in Table VIII. For the limited specific gravity range under observation, rectilinear equations passing through the zero point of origin are entirely satisfactory for certain strength properties. For other strength properties, curvilinear equations with a power of specific gravity larger than unity may be found more suitable to express this relationship, particularly if the specific gravity range is larger than the one under consideration. According to the test data previously referred to (2), the actual percentage increases in average strength properties of yellow poplar from the single tree at 8.5 to 8.9 per cent moisture content for every per cent increase in specific gravity for given specific gravity ranges could be determined and are shown in Table IX. These percentage increases are based on average values from test data, the individual values of which, in many cases, show a considerable deviation from these averages.

The correlation of specific gravity with strength properties of an individual *species* was determined for yellow poplar (4) and white ash (5), as shown in Table VIII. The correlation, as determined for a much larger specific gravity range found for these species than for the

TABLE VII.—VARIATION IN MODULUS OF ELASTICITY IN COMPRESSION PARALLEL TO GRAIN WITHIN *STICK* FOR TOTAL SPECIMEN LENGTH AND VARIOUS GAGE LENGTHS.

Test Sign	Modulus of Elasticity in Compression, psi.					
	8-in. Length	6-in. Gage	5½-in. Gage	5-in. Gage	4½-in. Gage	4-in. Gage
10-4a.....	1 339 000	1 697 000	...	...	...	...
	1 330 000	...	1 682 000	...	...	...
	1 364 000	...	...	1 744 000	...	...
	1 332 000	...	...	...	1 875 000	...
	1 359 000	...	...	...	...	1 404 000
Average.....	1 345 000					
10-4b.....	1 363 000	1 525 000	...	...	...	...
	1 415 000	...	1 677 000	...	...	...
	1 394 000	...	...	1 622 000	...	...
	1 415 000	...	...	...	1 731 000	...
	1 282 000	...	...	...	...	(1 781 000)
Average.....	1 374 000					
10-4c.....	1 285 000	1 601 000	...	...	...	...
	1 354 000	...	1 437 000	...	...	...
	1 354 000	...	...	1 482 000	...	...
	1 310 000	...	...	...	1 587 000	...
	1 312 000	...	...	...	...	1 621 000
Average.....	1 323 000					
10-4d.....	1 139 000	1 584 000	...	...	...	...
	1 216 000	...	1 545 000	...	...	...
	1 236 000	...	...	1 490 000	...	...
	1 240 000	...	...	...	(1 514 000)	...
	1 216 000	...	...	...	...	1 490 000
Average.....	1 209 000					
Grand Average....	1 313 000	1 602 000	1 585 000	1 595 000	(1 677 000)	(1 574 000)

TABLE VIII.—CORRELATION OF SPECIFIC GRAVITY (G) WITH STRENGTH PROPERTIES WITHIN AND AMONG SPECIES.

Strength Property	General Limitations	Within Species					Among
	Species Limitations	Yellow Poplar				White Ash	163 Species
	Origin Limitations	Stick		Tree	Species		
	Strength	At 7.1 per cent Moisture Content		At 8.5 to 8.9 per cent Moisture Content	For 12 per cent Moisture Content	Green	For 12 per cent Moisture Content
	Specific Gravity	At 7.1 per cent Moisture Content	Oven-dry	Oven-dry	Weight When Oven-dry; Volume at 12 per cent Moisture Content		
	Source	Fig. 5		Reference 2	Reference 4	Reference 5	
Flexure	Proportional limit, psi.	.....	.....	14 000G; 21 500G$^{1.5}$	.....	.....	16 700G$^{1.25}$
	Modulus of rupture, psi.	.....	.....	24 500G; 37 500G$^{1.5}$	37 000G$^{1.5a}$	24 000 $\sqrt{G^3}$	25 700G$^{1.25}$
	Modulus of elasticity, psi.	.....	.....	3 650 000G; 4 500 000G$^{1.25}$	4 400 000G$^{1.25}$	.....	2 800 000G
Toughness	Ultimate strength, in.-lb.	.....	.....	1 650G; 900G^3	1 020G^3; 870G^3	.....	.....
Compression parallel to grain	Proportional limit, psi.	33 500G$^{2.5}$	36 000G$^{2.5}$	8 750G	.....	.....	8 750G
	Ultimate strength, psi.	43 000G$^{2.5}$	47 000G$^{2.5}$	15 000G; 18 000G$^{1.25}$	16 300G$^{1.25a}$	.....	12 200G
	Modulus of elasticity, psi.	.....	10 900 000G$^{2.5}$	4 000 000G	.....	.....	3 380 000G
Tension parallel to grain	Proportional limit, psi.	.....	.....	20 500G	.....	.....	.....
	Ultimate strength, psi.	.....	.....	30 000G	.....	.....	.....
	Modulus of elasticity, psi.	.....	.....	4 600 000G	.....	.....	.....
Shear parallel to grain	Ultimate strength, psi.	.....	.....	2 850G; 4 350G$^{1.25}$	4 500G$^{1.5}$	.....	.....
Compression perpendicular to grain	Proportional limit, psi.	.....	.....	.....	4 900G$^{2.5}$	.....	4 630G$^{2.25}$

[a] Also for specific gravity according to oven-dry weight and volume.

single yellow poplar tree, is represented by powers of specific gravity of 1.25 to 3.0. These relationships lead to the conclusion that the similar relationship for a single tree with wide specific gravity range can possibly be better represented by powers of specific gravity larger than unity.

TABLE IX.—PERCENTAGE INCREASE IN AVERAGE TEST DATA FOR YELLOW POPLAR FROM SINGLE *TREE* AT 8.5 TO 8.9 PER CENT MOISTURE CONTENT PER 1 PER CENT INCREASE IN SPECIFIC GRAVITY FOR GIVEN SPECIFIC GRAVITY RANGE.

Strength Property	Proportional Limit	Ultimate Strength	Modulus of Elasticity
Flexure	0.00 (0.41 to 0.46)	0.39 (0.39 to 0.48)	0.83 (0.39 to 0.48)
Toughness value	...	0.85 (0.39 to 0.48)	...
Compression parallel to grain	1.05 (0.39 to 0.47)	0.06 (0.41 to 0.48)	0.83 (0.41 to 0.46)
Tension parallel to grain	0.23 (0.39 to 0.49)	0.73 (0.39 to 0.49)	0.65 (0.39 to 0.49)
Shear parallel to grain	...	1.60 (0.39 to 0.43)	...

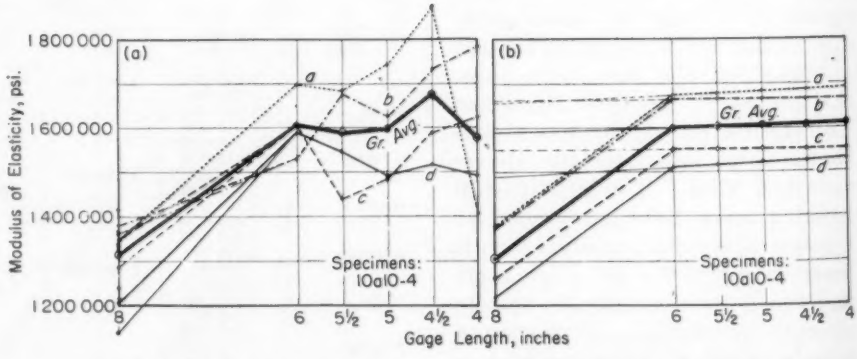
The general relationship of average specific gravity values with average strength properties of wood from *163 different species* grown in the United States (5), as shown in Table VIII, is represented by powers of specific gravity slightly lower than those representative for strength properties of wood within a species. The previously discussed elimination of extreme test values in correlating average specific gravity with average strength properties is the reason for this more rectilinear relationship.

Variations in Strength Properties as a Result of Variations in Specific Gravity

During studies related to strength properties of wood, it is important to give full consideration to the nonhomogeneity of the material. The moduli of elasticity in compression parallel to grain obtained for the total length and various gage lengths of four matched specimens from the previously described yellow poplar stick showed little correlation of the data for the gage lengths of 4 to 6 in., as illustrated in Fig. 6 (*a*). When corrected, however, as shown in Table X, for variation in specific gravity, indicated in Fig. 1, the moduli of elasticity allow an accurate analysis, as diagrammatically presented in Fig. 6 (*b*), of the various factors involved. Thus, (1) the influence of stress conditions at the ends of the test specimens, and (2) the minute, but consistent, yet negligible influence of the variation in gage length, attributable to the change in unbalance of the compressometer, on the test properties under consideration could be accurately analyzed only upon consideration of the influence of minute variations in specific gravity of the uniformly appearing test material.

This example of influence of variation in specific gravity on the test data illustrates what a relatively large influence a −5.4 to +4.1 per cent variation in specific gravity from the average value may have on the test data and results. Larger variations in specific gravity, as representative for specimens from a plank, bolt, tree, species, and various species, of course, have an even larger effect on the test data.

As previously shown, the specific gravity of yellow poplar within the tested stick varied from −5.4 to +4.1 per cent, within the tested planks from −12.7 to +18.9 per cent, within the bolts from −14.7 to +20.9 per cent, within the tree from −14.4 to +20.4 per cent, within the species from −33.2 to



(*a*) According to test data.

(*b*) Corrected for minute variations in specific gravity.

Fig. 6.—Moduli of Elasticity in Compression Parallel to Grain, Obtained for Total Length and Various Gage Lengths of Test Specimens from Yellow Poplar Stick of 3-ft. Length and 2 by 2 in. in Section.

TABLE X.—CORRECTION, FOR VARIATION IN SPECIFIC GRAVITY, OF TEST MODULI OF ELASTICITY IN COMPRESSION PARALLEL TO GRAIN, OBTAINED FOR TOTAL LENGTH AND VARIOUS GAGE LENGTHS OF TEST SPECIMENS FROM YELLOW POPLAR *STICK* OF 3-FT. LENGTH AND 2 BY 2 IN. IN SECTION.

Gage Length, in.	Test Specimen 10a10-4a			Test Specimen 10a10-4b			Test Specimen 10a10-4c			Test Specimen 10a10-4d			Average for Stick 10a10-4		
	Specific Gravity, average	Test Modulus, psi.	Corrected Modulus, psi.	Specific Gravity, average	Test Modulus, psi.	Corrected Modulus, psi.	Specific Gravity, average	Test Modulus, psi.	Corrected Modulus, psi.	Specific Gravity, average	Test Modulus, psi.	Corrected Modulus, psi.	Specific Gravity, average	Test Modulus, psi.	Corrected Modulus, psi.
8	0.4710	1 345 000	1 383 000[b]	0.4708	1 374 000	1 381 000[b]	0.4569	1 323 000	1 270 000[b]	0.4506	1 209 000	1 220 000[b]	0.4623	1 313 000	1 313 000[b]
6	0.4722	1 697 000	1 673 000[a]	0.4710	1 525 000	1 663 000[a]	0.4567	1 601 000	1 549 000[a]	0.4518	1 584 000	1 509 000[a]	0.4629	1 602 000	1 598 000[a]
5½	0.4727	1 682 000	1 677 000[a]	0.4711	1 677 000	1 664 000[a]	0.4569	1 437 000	1 550 000[a]	0.4525	1 545 000	1 515 000[a]	0.4632	1 585 000	1 601 000[a]
5	0.4732	1 744 000	1 681 000[a]	0.4712	1 622 000	1 665 000[a]	0.4569	1 482 000	1 550 000[a]	0.4534	1 490 000	1 522 000[a]	0.4637	1 595 000	1 605 000[a]
4½	0.4737	1 875 000	1 685 000[a]	0.4712	1 731 000	1 665 000[a]	0.4570	1 587 000	1 551 000[a]	0.4539	(1 514 000)	1 526 000[a]	0.4640	(1 677 000)	1 607 000[a]
4	0.4744	1 404 000	1 690 000[a]	0.4714	(1 781 000)	1 666 000[a]	0.4570	1 621 000	1 551 000[a]	0.4542	1 490 000	1 529 000[a]	0.4642	(1 574 000)	1 609 000[a]
Average 6 to 4	0.4732	1 680 000	1 680 000[a]	0.4712	(1 667 000)	1 665 000[a]	0.4569	1 546 000	1 550 000[a]	0.4532	(1 525 000)	1 521 000[a]	0.4636	(1 607 000)	1 604 000[a]

[a] Corrected for variation in specific gravity according to average specific gravity for 6, 5½, 5, 4½, 4-in. gage lengths: $E = 8{,}000{,}000G - 2{,}105{,}000$ (psi.).
[b] Corrected for variation in specific gravity according to average specific gravity for 8-in. length: $E = 8{,}000{,}000G - 2{,}385{,}000$ (psi.).

+26.7 per cent from the respective average data. Since the strength properties vary with the 1.0 to 3.0 power of specific gravity, as shown for individual test data for matched specimens, small differences in specific gravity must result in large differences in strength properties and relatively large differences in specific gravity affect the strength properties to an even larger extent. Thus, for instance, the reported extreme variations in specific gravity from −33.2 to +26.7 per cent from the average of 0.434 for the yellow poplar species, with a specific gravity range from 0.29 to 0.55, would call for moduli of elasticity in compression parallel to grain ranging from 500,000 to 2,440,000 psi., if the equation for modulus equal 10,900,000 $G^{2.5}$ is applied, according to Fig. 5. However, the actual extreme test values observed for yellow poplar originating from a single tree with a specific gravity range of 0.37 to 0.52 were only as low as 1,260,000, but as high as 2,410,000 psi., with an average modulus of 1,750,000 psi. and an average specific gravity of 0.43.

A tabulation of observed averages and ranges for strength properties of yellow poplar is given in Table XI. The average variation for all property values given for specimens from a single yellow poplar tree is −32.6 and +33.9 per cent for minimum and maximum test values, respectively. On the other hand, the respective observed extreme variations are −62.7 and +76.8 per cent. It is obvious that the observed variations from average values for the yellow poplar species are much larger, as indicated in Table XI for several test properties.

Influence of Variations in Strength Properties on Design Data

The presentation of average strength data and average specific gravity values for as nonhomogeneous a material as wood may be somewhat misleading to the casual reader and user of tabulated properties, if his attention is not drawn to the possible and probable variations in values. This may particularly be the case if he is used to thinking along lines of more homogeneous materials, such as structural steel. Indication of the observed averages and ranges, on the other hand, would show the observed variations in strength properties as a result of variations in specific gravity and, thus, correctly influence the designer in selecting appropriate design data.

Design data are based on average properties as determined for the individual test data observed. These average properties are reduced by the various factors to be given consideration for the particular design under investigation, these factors usually being introduced under the general term of safety factor. Thus, the safety factor may give consideration to the influence of (1) nonhomogeneity and permissible deficiencies and defects of the material, (2) rate, method, and length of loading period, including creep and fatigue properties of the material, (3) size and form factor for the piece, (4) variations in moisture content and temperature, and (5) relatively small and unforeseen secondary stresses unaccounted for in the general computation. During observation of the possible effect of any of these influences on the determination of the design data, it may be found that the variation in specific gravity—thus in strength properties—of the nonhomogeneous material exerts a major, if not maximum effect. Thus, reduction of 20 per cent from the ultimate static compression strength may eliminate most dangers which can be attributed to fatigue (7). Exposure to creep may call for a reduction in ultimate static compressive strength of as much as 40 per cent (7). Both the reported variation in specific gravity for the minimum test value from the average value for the yellow poplar species and the observed lowest variation from the averages of all strength property values, listed in Table XI, were shown to be 33 per cent. On the other hand, the observed extreme variation for all the property values was shown to be 63 per cent.

By placing limitations on minimum allowable specific gravity, thus indirectly on the various strength properties, the effect of variability in strength properties on the factor of safety can be considerably reduced. Thus, specific gravity limitations in specifications for the structural use of wood are de-

TABLE XI.—OBSERVED TEST AVERAGES AND RANGES FOR STRENGTH PROPERTIES OF YELLOW POPLAR.

Strength Property	Origin Limitations	Tree (References 2, 3)			Species (Reference 4)		
	Moisture Content	At 8.5 to 8.9 per cent Moisture Content			For 12 per cent Moisture Content		
	Specific Gravity Determination	Oven-dry			Weight When Oven-dry; Volume at 12 per cent Moisture Content		
	Specific Gravity Average	0.432			0.434		
	Specific Gravity Range	0.37 to 0.52			0.29 to 0.55		
	Test Data	Average	Min.	Max.	Average	Min.	Max.
Flexure	Proportional limit, psi.	6 005	3 110 (−48.2%)	7 340 (+22.2%)	6 100	.....	.....
	Modulus of rupture, psi.	10 610	8 820 (−16.9%)	12 190 (+14.9%)	9 200; 9 400	5600 (−39.8%)	15 050 (+61.8%)
	Modulus of elasticity, psi.	1 585 000	1 345 000 (−15.1%)	1 815 000 (+14.5%)	1 420 000; 1 500 000	.....	.....
Toughness	Ultimate strength, in.-lb.	71.5	26.7 (−62.7%)	108.7 (+52.0%)	72	19 (−73.6%)	158.5 (+120.1%)
Compression parallel to grain	Proportional limit, psi.	3 810	2 195 (−42.4%)	4 960 (+30.2%)	3 550	.....	.....
	Ultimate strength, psi.	6 330	5 440 (−14.1%)	7 500 (+18.5%)	5 040; 5 290	2800 (−45.8%)	8 300 (+60.7%)
	Modulus of elasticity, psi.	1 751 000	1 257 000 (−28.2%)	2 410 000 (+37.6%)	.....	.....	.....
Tension parallel to grain	Proportional limit, psi.	8 840	4 400 (−50.2%)	13 100 (+48.2%)	.....	.....	.....
	Ultimate strength, psi.	13 030	9 820 (−24.6%)	18 130 (+39.1%)	.....	.....	.....
	Modulus of elasticity, psi.	1 980 000	1 425 000 (−28.0%)	3 500 000 (+76.8%)	.....	.....	.....
Shear parallel to grain	Ultimate strength, psi.	1 216	830 (−31.7%)	1 580 (+29.9%)	1 100; 1 120	.....	.....
Compression perpendicular to grain	Proportional limit, psi.	613	434 (−29.2%)	756 (+23.3%)	580	.....	.....
Average	.....	....	(−32.6%)	(+33.9%)	.....	.....	.....

sirable and have been used extensively. On the other hand, specific gravity limitations alone cannot fully guarantee the elimination of material with properties below those attributed to the specified minimum specific gravity value, if the specific gravity is not known or satisfactorily determined for every part of the structural member.

Determination of Specific Gravity and Strength Properties in Light of Their Variations

The observed variations in specific gravity and strength properties within a clear uniformly appearing piece of yellow poplar are evidence that single observations of these properties according to small test specimens may not be reliable enough to establish the desired properties for a large piece, lot or structure, and may even be misleading if assumed to be representative for the piece, lot or structure under observation. Whenever the observed data for a single small test specimen or a group of specimens approximate the specified minimum design data, it may be warranted to perform additional tests in order to determine whether all parts of the piece, lot or structure fulfill the minimum requirements. Additional tests may be duplicates or supplementary in character. Test sections may be taken from other representative locations than used for the first specimen or group of specimens. On the other hand, the specific gravity of the whole member may be determined by weighing and dimensioning it, and the observed specific gravity may be compared with the minimum specified for the member. Such control tests can be particularly satisfactory if a large number of uniform members are to be mass-produced or prefabricated and if their strength properties have to satisfy rigid specifications. Thus, automatic weighing systems can quickly test the specific gravity of mass-produced dimension stock for structural units even before it is finished.

Different testing procedures call for large or small test specimens for the determination of the specific gravity (1). The smaller the specimen, the less representative the test data may be for the member from which the test specimen is cut. Hence, whenever small test specimens are to be used, the number of specimens should be large enough and the specimens should originate from as representative locations as feasible, in order to assure that the observed data are fully representative for the piece, lot or structure under investigation. For certain investigations, it may even be advisable to determine the specific gravity of every section of the member under observation, as illustrated in Fig. 6. Thus, test data which appear erratic may be corrected for local variations in specific gravity and strength; and upon correction, previously uncorrelated data may exhibit previously unknown significance.

Summary

The demonstrated variations in specific gravity which occur within a stick, plank, bolt, tree, and species, and the correlated variations in strength properties are of decisive influence on the design data for wood and have to be given detailed consideration during studies of and related to strength properties of wood. Hence, large-size or a relatively large number of representative specimens have to be tested in order to obtain truly representative test data for the nonhomogeneous material, even if it should originate from the same stick, bolt, tree, location, or species.

References

(1) E. George Stern and Paul S. Dear, "A Simplified Method for the Determination of the Specific Gravity of Wood and Plastics," ASTM Bulletin, No. 135, August, 1945, pp. 35–40.

(2) E. George Stern, "Strength Properties of Yellow Poplar from Virginia," Virginia Polytechnic Inst. Engineering Experiment Station Bulletin No. 59, December, 1944.

(3) E. George Stern, "Strength Properties of Yellow Poplar from Virginia, Test Data," Virginia Polytechnic Inst. Wood Research Laboratory Release (typewritten), February, 1944.

(4) R. F. Luxford and L. W. Wood, "Survey of Strength and Related Properties of Yellow Poplar," U. S. Forest Products Laboratory Release No. 1516 (mimeographed), November, 1944.

(5) L. J. Markwardt and T. R. C. Wilson, "Strength and Related Properties of Woods Grown in the United States," U. S. Dept. of Agriculture Technical Bulletin No. 479, September, 1935.

(6) E. George Stern, "Strength Properties of Red Spruce from West Virginia," Virginia Polytechnic Inst. Engineering Experiment Station Bulletin No. 55, August, 1943, Fig. 3, p. 8.

(7) E. George Stern, "Modern Timber Construction in Europe," Virginia Polytechnic Inst. Engineering Extension Bulletin No. 45, November, 1946, p. 24.

Transitional Evaluations and Treatment of Experimental Data Subject to Very Wide Scatter

By Wendell P. Roop[1]

In this paper use will be made of certain data bearing on the effects of temperature on the ductility of steel. The general question to be discussed is: From numerical results of experiment known to be affected by scatter, but to an unknown degree, what procedure leads to the most complete and most certain information?

Conclusions about ductility are not the main objective, which is concerned rather with methods of analysis, and beyond these, of the planning of experiments. The particular set of data chosen[2] is used to give the process of analysis specific significance.

The data consist of a series of values of work done in causing rupture of a tension specimen. This quantity has the dimensions of energy per unit volume; it is designated by the symbol u and is taken as a measure of ductility. Its values are presented in association with values of three parameters, P, Q, and T. P and Q relate to the geometry of the specimen and T denotes temperature in degrees Fahrenheit. The end result desired in those tests was a statement of the functional relation between u and P, Q, and T. However, wide scatter is present and functional relationships cannot from these data be exactly defined.

Some information short of exact definition is obtainable. Simple scrutiny shows that trends exist (with many exceptions as to single points) as follows:

u tends to increase as (1) P increases, (2) Q diminishes, and (3) T increases.

The third of these trends is easily recognized, and the more specific description of its nature which follows is generally accepted. Above a temperature T_2, u has a consistently high value; below a lower temperature T_1, u has a consistently low value. Between T_1 and T_2 u has intermediate values subject to scatter. These facts are illustrated by Fig. 1. The interval between T_1 and T_2 is a transition zone.

This is a situation which recurs when a shift from one to another régime or mode of action occurs. Another example of transitional behavior is found in flow of water, where at velocities below a limit the motion is laminar in texture and at velocities above a higher limit the motion is turbulent.[3] Between the limits lies a zone of transition characterized by intermediate values of any function affected by régime, and especially by scatter.

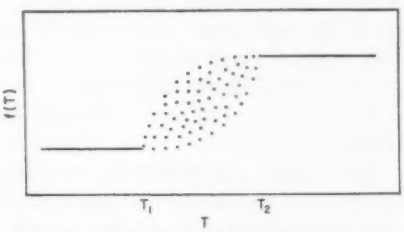


Fig. 1.—Schematic Transition Curve.

A primary center of interest lies in the limits outside which the phenomenon follows definite functional relationships with only moderate scatter. It is these relationships which are used in ordinary course of design, and the limits to their validity are important to recognize. Evaluation of these transitional limits is the subject of this paper.

It has come as a considerable shock to many persons engaged in studies in applied mechanics to learn that such limits of validity exist. Structures whose design was beyond reproach by accepted standards have simply fallen apart without showing in advance any signs of weakness, and there is little consolation in the fact that numerous others held together. The success of our designs has depended on assumptions not considered in the calculations and not always satisfied. It is the capacity of steel for smoothing out unrecognized concentrations which is in question. The word for this is *ductility*.

The designer cannot pass responsibility for this situation to the materials engineer and metallurgist. He must be sure that his design requires no quality which his material does not possess. How is he to have that assurance?

That is the question to be discussed. It has special reference to the set of data used, but the ideas presented can be applied to any other set of data in which the accepted functional relations, or laws of action, are affected by limiting parametric values beyond which scatter and uncertainty prevail. It is necessary in such a case to know the limits of the zone of uncertainty.

Usual Procedures

All engineers have an idea of the "Theory of Errors" and are accustomed to the fact that measurements vary in precision and that complete exactness in observation is illusory. Thus in observing what is regarded as a fixed quantity, the "most probable value" is a familiar concept and the procedure for finding it is standardized. The ordinary measures of dispersion, such as the mean error and the standard deviation, are in common use, and the distribution of observations about a central value (mean, median, mode) is a matter of common knowledge. A little more obscure are questions of correlation and of what makes up a random distribution. In the matter of what can be inferred from deviations from the normal distribu-

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[2] NOTE.—A presentation of the original data from which these have been derived has been made by H. R. Thomas of the David Taylor Model Basin in an unpublished report entitled: "Results of Tensile Tests of Flat Plate Specimens with Internal Notches." The type of notch used is described in that report. Its radius at the apex is an inverse measure of its acuity. This radius is the parameter P of the present report. The parameter Q is the depth of the notch, measured as the ratio of the whole width of the notch to that of the plate.

[3] W. P. Roop, "Laminar and Turbulent Flow about Ship Models," *Journal Franklin Institute*, Vol. 213, p. 195 (1932).

TABLE I.—TABLE OF OBSERVED DATA.

Observed energy absorption, u, is a function of P, Q, and T.

	T	u		T	u		T	u
	40	1578		−40	74		−40	2242
	78	1939	$P = 0.01$	0	156	$P = \frac{3}{8}$	0	2460
	84	2751	and	38	195	and	38	2348
$P = 0.01$	90	2757	$Q = \frac{1}{8}$	67	301	$Q = 0.24$	50	2404
and	90	3521		90	291		73	2160
$Q = \frac{1}{32}$	100	3920	$P = 0.01$	−40	57	$P = 0.04$	0	813
	110	3130	and	0	64	and	38	1364
	120	3687	$Q = \frac{1}{2}$	38	84	$Q = \frac{1}{8}$		
	150	3248		77	748		38	600
$P = 0.01$	−40	136	$P = 0.01$	−40	66		78	570
and	0	137	and	0	93		90	678
$Q = \frac{1}{8}$	38	544	$Q = \frac{3}{4}$	38	103	$P = 0.04$	100	1161
	80	1417		80	190	and	110	837
	38	100		−20	1409	$Q = 0.22$	110	1074
	78	343	$P = \frac{1}{8}$	0	1121		110	1292
	90	383	and	73	1278		120	1087
$P = 0.01$	100	700	$Q = 0.24$	100	1200		150	987
and	110	683		120	1391	$P = 0.04$	0	717
$Q = 0.22$	110	805		246	1630	and	38	674
	120	900		−40	1874	$Q = \frac{1}{4}$		
	120	896	$P = \frac{1}{4}$	0	1444	$P = 0.04$	0	496
	150	955	and	38	1482	and	38	474
	−40	42	$Q = 0.24$	74	1709	$Q = \frac{1}{2}$		
$P = 0.01$	0	91		110	1839	$P = 0.04$	0	339
and	38	150				and	38	339
$Q = \frac{1}{4}$	78	300				$Q = \frac{1}{2}$		
	100	934				$P = 0.04$	0	259
						and	38	374
						$Q = \frac{3}{4}$		

tion law little attention has been given to engineering applications.

A common variant of the problem arises when, instead of a fixed quantity, a variable one comes in question, and the need arises for expressing a functional relationship between two variables. From experiment one obtains data in the form of a series of pairs of related values. Each of these pairs may be plotted as a point in a Cartesian diagram, and an array of such points may at least serve to suggest an exact functional relation of the sort that may be represented by a curve. The need of running a curve through such an array of points presents the general problem of curve fitting.

When the dispersion of such data is not very high, no difficulty arises in discerning the form of a function which will afford a good fit, and once that much has been decided upon, evaluation of the coefficients which will give the best fit with that form of function is not difficult. The procedure known as "The Method of Least Squares" provides a standard process for doing it. But engineers usually by-pass such considerations and content themselves with simple plotting of data, using judgment and intuition in the choice of a path for the curve through the spots. It is assumed that the curve must be continuous, and the "French curves" used by draftsmen are made up on this basis. Such confidence is felt in this procedure that often the curves alone are shown, without the plotted points.

Even when the fitted curves have analytic expressions, this method of choice by simple scrutiny is usually followed, and when an empirical curve is considered to be good enough, the question of more elaborate methods hardly arises.

In the case now to be discussed these usual methods do not serve the purpose for the following reasons:

(*a*) The dispersion is so great that even the *form* of the function to be used in fitting a curve is not clear,

(*b*) The number of independent variables is not one, but three, and the data on most of the values of all three are so meager that use must be made of assumed similarity in adjacent members of a whole family of curves, and

(*c*) A major interest attaches to the transition limits.

The easiest observation to make with respect to such requirements is that more data are needed. This is not enough to close the subject. Even if more data are to be taken, the work must be planned with benefit of what is already known, and with recognition of uncertainties. But very often no more data can be taken. One must use every resource in squeezing conclusions out of what data there are.

The Material Test

It is now agreed that the standard tension test cannot give the desired assurance as to the temperature limits of ductility. Recourse has been had to the Charpy test and to a great variety of others intended to offer a measure of ductility. This is not the place to discuss their merits; none of them has won general approval.

The data to be used here for illustration were obtained in course of a test designed with the same intention. The purpose of the experiments was to define for a given material the effects of the parameters P and Q upon the limits T_1 and T_2. This was not achieved.

The steps taken in the analysis of these data will now be traced, with comment. The data themselves are given in Table I.

Procedures of Analysis

The first—in many cases the only—operation to be performed with such data is to reduce them to graphical form by plotting. In view of the known importance of temperature, the natural thing is to plot u on T for each combination of P and Q.

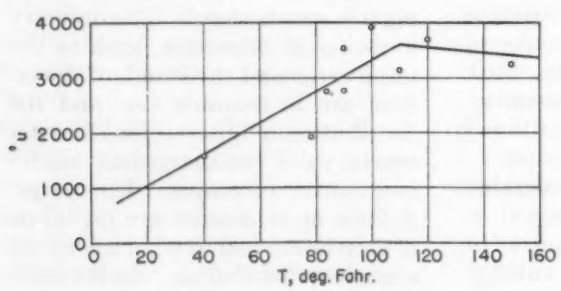


Fig. 2.—Transition Curve Fitted to Data for $P = 0.01$, $Q = \frac{1}{32}$.

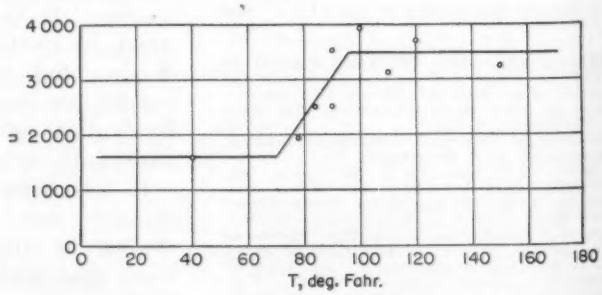
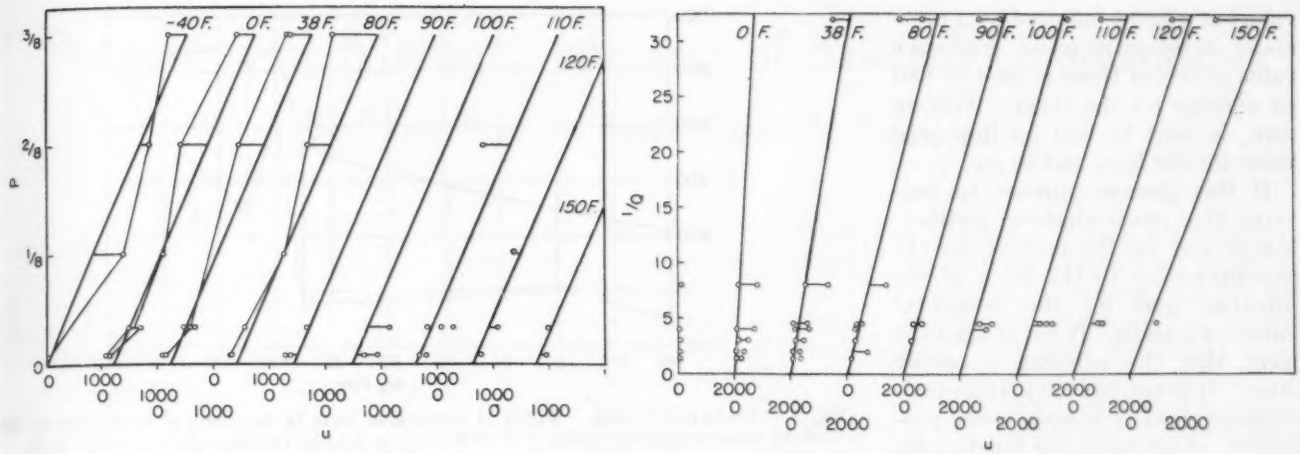


Fig. 3.—Alternate Transition Curve Fitted to Same Data as in Fig. 2.



(a) Plotted with P on a series of constant T. (b) Plotted with Q on a series of constant T.

Fig. 4.—Fitted Curves Based on $u = aP + b/Q$.

For the case $P = 0.01$, $Q = 0.22$, this turns out to indicate that the whole temperature interval used falls within the transition range. However the nearby group at $P = 0.01$, $Q = \frac{1}{4}$, suggests a value of the lower limit, T_1, of 30 F. Above this point the straight line

$$u_E = 8(T - 20)$$

gives a correlation of 75 per cent between the observed value, u_O, and the expected value, u_E, and a standard error of estimate of 130 in a mean value of 600.

This can be taken as an acceptable piece of curve fitting under the circumstances, but it does not solve the problem. None of the groups of data at other values of P and Q produces a result comparable with this in a way leading to the desired inference. In the case of $P = 0.04$, $Q = 0.22$, the rise of u with T is hardly more than suggested, and other cases are even more vague. If it be supposed that the scatter is due to chance deviations from a mean independent of T, the question still remains whether the range explored is above or below the transition.

To increase the number of observations available for plotting the groups of data at $P = 0.04$, $Q = 0.22$, $\frac{1}{4}$, $\frac{1}{3}$, $\frac{1}{2}$, $\frac{3}{4}$ were drawn upon and all reduced to $Q = \frac{1}{4}$ by a simple procedure of *correction*. This yielded 17 items which showed a rise of u with T of possible significance. This would indicate that the temperatures chosen lie within the transition range. But the indications are too vague to permit any inference about the limits of the transition range.

Another group of data worth special attention is that at $P = 0.01$, $Q = \frac{1}{32}$; these are the only ones positively suggesting a value for T_2, the limit above which the value of u levels off. These data are plotted in Fig. 2, with a curve which fits the data with high correlation, 85 per cent, and a low error of estimate, 275 in 3000. The upper temperature limit indicated is 110 F. A still better fit is shown with the same data in Fig. 3. The difference between the curves lies in the choice of type of function. Figure 2 is thought, from other knowledge, to come nearer the truth.

An effort was made to combine judgment with formal statistical procedures by laying out a family of curves in which the form of the curve produces a good fit in each case where the data are numerous enough, and for the rest a set of parameters was chosen in a systematic way so as to match the isolated spots by drawing in a whole curve belonging to the family. In this way high correlations and moderate errors of estimate were again found, and the significance tests applied were not unfavorable. Nevertheless the method does not in these data discriminate among different assumptions as to the temperature limits.

Plotting was also tried in a different manner, by grouping all data at a given temperature and plotting on P and Q. In this way u was found at each temperature to be roughly proportionate to P and to $1/Q$. By using these relations the whole body of data was reduced to terms of $P = 0.01$, $Q = \frac{1}{4}$. All the values thus found were then averaged for each of a series of values of T. These results were plotted in terms of the quantity b in the equation

$$u = aP + b/Q$$

It is found that a is not affected by T, and that b jumps by a discontinuity to a doubled value at about $T = 90$ F.

This at last seems to give something fairly definite. We now turn to an appraisal of the certainty and significance of this result.

Procedure in Evaluation of Results

Three tentative inferences from the data are thus suggested:

(*a*) at constant T, u is proportional to P,

(*b*) at constant T, u is inversely proportional to Q, and

(*c*) a transition from low to high values of u occurs at about 90 F.

This is summarized in the formula

$$u = aP + b/Q$$

and the idea that $b = f(T)$ shows a discontinuity which is the main point of interest.

Evaluation of a and b by routine procedures is a problem of the type discussed under the caption "multiple correlation." The standard procedures have not been carried through, as they are too long for the resources available. The methods which have been used may be regarded as serving only for reconnaissance. They consist in the use of first-order guesses at numerical

values of a and b followed by a process of iteration in which a guessed value of one of them is used to find an average for the other. This, in turn, is used to find an improved value for the first, and so on.

If this process appears to converge, that offers whatever justification it may for the process, for the assumption as to the form of the function, and for the numerical values of a and b. It has at least the merit that the guessing is openly done. It is not left implicit and unacknowledged as in more usual procedure, which infers the function by simple plotting and inspection, leaving aside all estimate of validity.

What is now to be considered, however, is a criterion by which the result of such an operation is to be judged, regardless of the process by which the tentative conclusion about form of the function and values of the coefficients has been reached. For this purpose comparison is to be made between the two attempts to discern some regularity in the data. In the first of these all the curve-fitting efforts were bent directly toward the temperature transition. It was found that equally high correlations between observed and expected values could be had from either of two assumptions for the expected values: that transition temperature (a) diminishes, or (b) is unchanged by increasing P. From this it appeared that no conclusion about the transition curve could be drawn from these data. One exception to this conclusion was found in the series at $Q = \frac{1}{14}$, which showed a leveling-off of u above about 90 F. Otherwise nothing was established beyond a trend toward higher u with higher T at all values of P and Q.

Routine statistical procedures showed high correlations and low errors of estimate with either of the two hypotheses about transition temperature. The standard chi-square test indicates that the sample analyzed departed from the normal distribution so widely that the chance of a similar departure in another sample was only 1 in 7. This seemed to indicate that any conclusions from this sample which involved the assumption of random deviations of observed from expected values would have a low order of certainty.

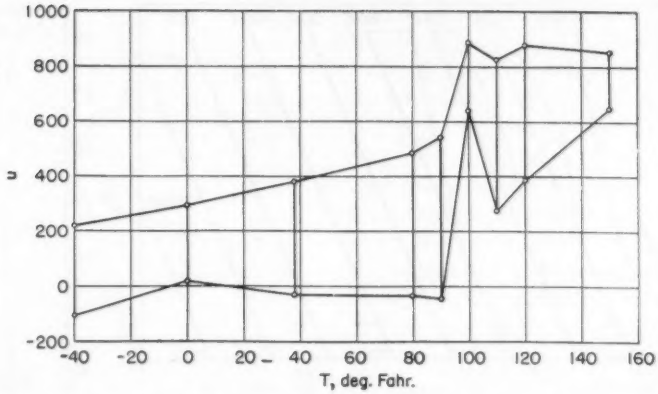


Fig. 5.—Transition Curve. Width of dispersion zone is in terms of mean error. All data were reduced to terms of $P = 0.01$, $Q = 0.25$ by the formula $u - aP + b/Q$, where:

$$a = 6700,$$
$$b = 30 + 0.9T.$$

To be compared with this is the result of plotting on P and Q at a series of constant T values, as in Figs. 4 (a) and (b). This indicates a temperature limit about 90 F., below which u is diminished at all values of P and Q. An idea of the success of this maneuver may be had from Fig. 5. Correlation of observed and expected values is again high, error of estimate low.

Can the significance of this result be confirmed by a numerical test? The calculation of chi-square leads to a chance-ratio of only $\frac{1}{16}$ compared with $\frac{1}{7}$ as in the previous case. This suggests that the results are even less certain than in the earlier case where the transition curves were plotted directly.

The net result is that the formula

$$u = aP + b/Q$$

is not strongly supported. It must be regarded as nothing more than a hypothesis perhaps worthy of further study.

Conclusion

Further tests are needed, but, if for any reason they are not possible, the hypothetical formula gives the best available guess. With the tentative formula in hand a new schedule of tests can be laid out to give a large amount of information with a small number of tests.

A conclusion certain to be drawn, though assuredly false, is that the statistical analysis is futile. Such adverse criticism would be better directed to other series of tests, much briefer and less conclusive, to which no statistical analysis has been applied. It is quite true that the methods of statistics are sometimes misused in an effort to bolster preconceived ideas. This fact is known and has brought some disrepute to the statistical method. A greater disrepute should attach to the widespread practice of disregarding scatter and jumping to conclusions. Data that cannot meet statistical tests must be treated with skepticism.

Recommendations

In further extension of work on ductility of steel and in similar work with data of high dispersion relating to transition limits, it is recommended that:

1. The best possible estimate of the transition limit be made in advance and a series of tests run under appropriate conditions unvaried until a good idea of dispersion is obtained.
2. That parameters be varied by changing only one at a time, with continuous attention to dispersion.
3. That each choice of parameter values for new tests be made in the full light of work already done.

Where, as in the present case, the scatter is so great that a rather large number of tests is needed to give the desired information, continuous attention to the statistical aspects of the data will serve to guide choice of parameter values so as to require the minimum total volume of work. The statistical method cannot add to the information to be had from a given set of data, as might be done if it could somehow reduce scatter, but it can prevent disappointments by leading directly to the best obtainable results.

Properties of Masonry Mortars of Several Compositions

By David Watstein[1] and Norman A. Seese, Jr.[1]

MASONRY mortars commonly used in construction contain as cementing material a mixture of portland or other cement with lime in different proportions, or proprietary mixtures of cements with various plasticizers. A study of twenty-one representative mixes was made in an attempt to appraise them from the standpoint of strength of bond between bricks and mortar, and resistance of the mortars to cracking resulting from shrinkage upon drying. Of the twenty-one cementing materials tested, fifteen were portland cement-lime mixes, two were slag cement-lime mixes, and four were preparations marketed as masonry cements.

SPECIFICATION TESTS OF MATERIALS

Cements:

The masonry and slag[2] cements were tested according to A.S.T.M. Standard Specifications for Masonry Cement (C 91 – 40),[3] except that, instead of being tested in steam, the pats were tested for soundness in air and water as required by Federal Specification SS-C-181b. The results of these tests are given in Table I, along with data on water repellency and expansion in the autoclave.[4]

The portland cement used in this study met the requirements of A.S.T.M. Standard Specifications for Portland Cement (C 150 – 46)[5] for Portland Cement of Type I; the test results are given in the following table:

Time of setting Gillmore test	
Initial	4 hr. 45 min.
Final	8 hr. 0 min.
Tensile strength	
3 days	325 psi.
7 days	375 psi.
Specific surface	1730 sq. cm. per g.
Autoclave expansion	0.02 per cent

Limes:

The properties of the five limes used in this study were determined according to the A.S.T.M. Standard specifications for Normal Finishing Hydrated Lime (C6 – 44)[6] and Standard Specifications for Quicklime for Structural Purposes (C 5 – 26),[7] respectively). The results of the tests are given in Table II. In addition to the regular test for soundness in steam, lime-plaster of paris pats were subjected to an autoclave test for popping, in accordance with the A.S.T.M. Tentative Methods of Physical Tests for Limestone, Quicklime and Hydrated Lime (C 110 – 45 T).[8] Water retentivity of lime-standard Ottawa sand mixes (1:3, by weight) was also determined, following the general procedure given in A.S.T.M. Standard Specifications for Masonry Cement (C 91 – 40);[3] Emley plasticity values of all hydrated limes were measured after 18-hr. soaking in accordance with A.S.T.M. Specification C 6 – 44[6] and, in addition, after soaking for 15 min.

Sand:

Potomac River concrete sand, passed through a No. 8 sieve and having a fineness modulus of 2.27, was used as the aggregate. The sieve analysis of the sand is given in the following table:

Sieve No.	Percentage Passing
No. 8	100
No. 16	89
No. 30	59
No. 50	20
No. 100	5

Brick:

Red side-cut shale brick made in West Virginia were used in the assemblages for determining the tensile bond strength of the mortars. Only those brick whose rate of absorption lay in the range of from 5 to 15 g. of water per minute were used in the cross-brick bond-test specimens.

The properties of the brick, determined according to the A.S.T.M. Standard Methods of Sampling and Testing Brick (C 67 – 44),[9] are listed in the following table:

Modulus of rupture, psi	2 700
Compressive strength, psi	16 200
Absorption, 24-hr. cold immersion, per cent	2.1
Absorption, 5-hr. boiling, per cent	4.1
Saturation coefficient	0.51

Mortars:

The weight proportions of the mortars were calculated on the basis of the following assumed specific weights of the components:

Material	Weight of 1 cu. ft., lb.
Portland cement	94
Slag cement	79
Masonry cement	As specified by manufacturer
Hydrated lime	40
Dry sand	80

The proportions of the mortars are given in Table III.

DESCRIPTION OF TEST SPECIMENS AND TEST PROCEDURE

The water content of the mortar for all specimens was adjusted to produce a flow of 100 to 115 per cent immediately after mixing. All compression and shrinkage specimens, immediately after molding, were placed in a moist closet for a period of from 24 to 72 hr. After removal from molds, the specimens

TABLE I.—SPECIFICATION TESTS OF MASONRY AND SLAG CEMENTS.[a]

Type of cement	Masonry	Masonry	Masonry	Masonry	Slag	Slag
Designation	1	2	3	4	1	2
Fineness—Per cent retained on No. 200 sieve	0.50	0.50	1.47	4.21	0.90	1.37
Time of setting—Initial	OK	OK	OK	OK	OK	OK
Time of setting—Final	OK	OK	OK	OK	OK	OK
Soundness—Air	OK	OK	OK	OK	OK	OK
Soundness—Water	OK	OK	OK	OK	OK	OK
Water repellency	0.34	0.35	0.37	0.33	0.29	0.61
Water retention, per cent	82	81	82	76	83	55
Compressive strength at 28 days, psi	1665	2115	1800	1690	1875	1795
Expansion in autoclave, per cent	1.07	0.12	0.04	0.10	0.04	0.0

[a] The masonry and slag cements were tested according to A.S.T.M. Specifications for Masonry Cement (C 91 – 40),[3] except that the pats were tested for soundness in air and water as required by Federal Specification SS-C-181b.

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to A.S.T.M. Headquarters, 1916 Race St., Philadelphia 3, Pa.

[1] Engineer and Jr. Engineer, respectively, National Bureau of Standards, Washington, D. C.

[2] A mixture of ground blast-furnace slag and lime.

[3] 1946 Book of A.S.T.M. Standards, Part II, p. 7.

[4] Water repellency and expansion in the autoclave determined according to Federal Specifications SS-C-181b and SS-C-158a, respectively.

[5] 1946 Book of A.S.T.M. Standards, Part II, p. 1.

[6] 1944 Book of A.S.T.M. Standards, Part II, p. 85.

[7] 1946 Book of A.S.T.M. Standards, Part II, p. 90.

[8] 1946 Book of A.S.T.M. Standards, Part II, p. 1310.

[9] 1946 Book of A.S.T.M. Standards, Part II, p. 183.

TABLE II.—SPECIFICATION TESTS OF LIMES.[a]

Type of lime	High Calcium Hydrated Lime	High Calcium Hydrated Lime	Regular Dolomitic Hydrated Lime	Pressure Hydrated Dolomitic Lime	Pulverized High Calcium Quicklime (as Putty)
Designation	1	2	3	4	5
Soundness test: Regular	OK	OK	OK	OK	OK
Soundness test: Autoclave[b]	OK	OK	OK	OK	OK
Plasticity: 15-min. soaking	130	90	130	390	...
Plasticity: 18-hr. soaking	180	250	510	530	370
Water retentivity of 1:3 lime-standard Ottawa sand mix, per cent[c]	90	74	89	94	95
Unhydrated or free oxide (MgO) per cent	2.3	1.1	26.2	3.0	Not determined

[a] Limes tested according to A.S.T.M. Specifications for Normal Finishing Hydrated Lime (C 6 – 44)[6] and Specifications for Quicklime for Structural Purposes (C 5 – 26).[7]
[b] Lime-plaster of paris pats tested in an autoclave in accordance with A.S.T.M. Tentative Methods of Physical Tests for Lime (C 110 – 38 T).[8]
[c] Determined according to the general procedure given in A.S.T.M. Specifications for Masonry Cement (C 91 – 40).[5]

were kept in a moist atmosphere until the age of 7 days, after which they were placed in water for 21 more days. The brick assemblages were cured in air in the laboratory from the time they were made until they were tested at 28 days.

The specimens designed for measuring the resistance of mortars to cracking were 2 by 2 by 12-in. prisms, both plain and reinforced. The reinforced prisms contained a centrally placed reinforcing bar $\frac{1}{2}$ in. in diameter. The closely spaced lugs on this bar provided a high resistance to slipping. The ends of the bar were flush with the ends of the mortar prism and reference points for measurement of length changes were steel balls pressed into the ends of the reinforcing bar. Similar reference points were embedded in the ends of the plain mortar prisms.

Both the plain and the reinforced prisms were measured periodically in a comparator for length changes while being exposed to air in a constant temperature room. It is noted that the plain prisms were measured to determine their shrinkage, and the reinforced prisms to detect the presence of tensile cracks whose formation was generally accompanied by an appreciable change in the lengths of the reinforcing bars.

Measurement of length changes of the plain and reinforced prisms was begun when these specimens were first exposed to drying at the age of 28 days. Daily measurements were made on most of these specimens until shrinkage cracks were observed in the reinforced prisms. Thereafter, measurements were made at progressively less frequent intervals. The mortar prisms were exposed to air in a laboratory where the temperature was maintained at 70 ± 2 F. and the relative humidity at 50 ± 5 per cent.

The cross-brick specimen for measurement of tensile bond strength is illustrated in Fig. 1. In preparing the specimens, the three bottom brick were first bedded in dry sand in order to produce a level surface for bedding the top brick. The mortar was spread in a $\frac{3}{4}$ by $4\frac{1}{2}$ by $8\frac{1}{2}$-in. template laid over the three bottom brick and was struck off level. The template was then removed and the top brick was placed on the prepared bed of mortar 1 min. after the mortar was first deposited. The top brick was then tapped with a fist until, in the judgment of the operator, complete contact between the top brick and the mortar was attained. The resulting

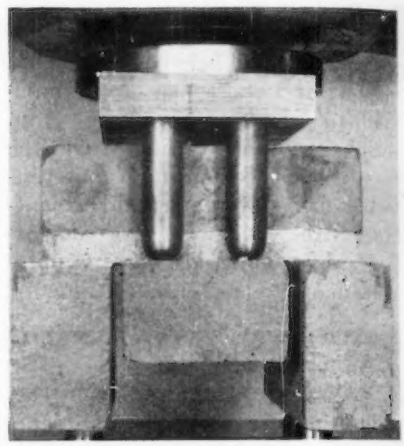


Fig. 1.—Cross-brick Tension Bond Specimen.

thickness of the joint was about $\frac{1}{2}$ to $\frac{5}{8}$ in.

The compressive strength of the twenty-one mortars was determined with 2-in. cubes molded, cured, and tested in accordance with A.S.T.M. Specifications C 91 – 40.[3]

In so far as it was possible, only one third of specimens representing

TABLE III.—PROPORTIONS, COMPRESSIVE STRENGTH, BOND STRENGTH IN TENSION, AND WATER RETENTIVITY OF MORTARS.

Designation of Mortar	Type of Cement in Mortar	Proportions, by Volume: Cement	Lime Hydrate	Sand	Proportions, by Weight: Cement	Lime Hydrate	Sand	Variable Component in Group of Mortars	Mixing Water by Weight of Dry Materials, per cent	Compressive Strength, psi.	Brick Assemblages: Bond Strength in Tension, psi.: Average	Individual Values	Coefficient of Variation, per cent	Water Retentivity, per cent
1PL1	Portland	1	0.2	3	1	0.11	2.55	Lime 1	15.1	6560	66	63 37 63 67 95 70	26	73
1PL2								Lime 2	14.9	6500	66	66 46 98 64 80 44	29	67
1PL3								Lime 3	14.9	6550	74	63 72 86 65 78 79	11	74
1PL4								Lime 4	15.1	6170	79	75 65 74 67 115 78	22	78
1PL5								Lime 5	15.1	6180	62	60 63 76 59 62 53	11	74
2PL1	Portland	1	1	6	1	0.53	5.11	Lime 1	17.5	1830	44	36 47 50 43 51 37	13	84
2PL2								Lime 2	16.4	2035	37	30 34 49 39 42 31	17	69
2PL3								Lime 3	17.0	2030	45	61 29 49 38 49 43	22	75
2PL4								Lime 4	17.4	1700	67	78 77 63 62 83 41	21	89
2PL5								Lime 5	17.0	1710	50	52 54 51 50 53 38	12	85
3PL1	Portland	1	2	9	1	1.06	7.66	Lime 1	19.0	690	29	28 17 29 38 29 31	22	85
3PL2								Lime 2	17.6	780	29	31 34 31 27 34 16	20	72
3PL3								Lime 3	18.3	790	52	49 60 51 52 37 66	15	84
3PL4								Lime 4	19.1	670	49	39 57 48 56 37 55	16	91
3PL5								Lime 5	18.4	660	42	53 36 45 33 45 40	15	85
M1	Masonry	1	..	3	1	..	3.69	Masonry cement 1	15.2	1070	43	56 51 33 50 40 31	22	74
M2					1	..	3.43	Masonry cement 2	14.4	1310	43	46 46 58 25 51 31	26	80
M3					1	..	3.43	Masonry cement 3	15.8	1105	44	44 45 59 40 36 43	16	83
					1	..	3.43	Masonry cement 4	14.6	1100	32	40 26 22 32 44 27	25	76
SL1	Slag	1	0.5	4.5	1	0.32	4.56	Slag cement 1	17.8	1070	21	24 22 17 17 13 31	21	87
SL2								Slag cement 2	17.2	1220	26	9 16 17 22 38 54	60	79
								(Lime 1 used in this group of mortars)						

TABLE IV.—RELATIVE RESISTANCE OF MORTARS TO CRACKING.

Mortar	Column A: Length of Storage of Six Individual Reinforced Prisms in Air at the Time of Formation of First Crack, days						Column B: Shrinkage Observed in Plain Prisms at the Time of Appearance of First Crack in Reinforced Prisms, per cent						Column C: Median Value of Column B, per cent	Column D: Shrinkage Observed in Plain Prisms after 180 Days in Air. (Arithmetic mean for 6 prisms), per cent	Column E: Ratio of Value in Column C to Value in Column D
1PL1	9	9	14	14	15	20	0.049	0.049	0.063	0.063	0.066	0.076	0.063	0.124	0.50
1PL2	8	11	14	14	14	20	0.039	0.048	0.055	0.055	0.055	0.066	0.055	0.113	0.48
1PL3	7	8	9	12	12	18	0.042	0.045	0.049	0.056	0.056	0.069	0.053	0.119	0.44
1PL4	8	9	9	9	14	18	0.048	0.052	0.052	0.052	0.066	0.074	0.052	0.124	0.42
1PL5	4	6	9	11	12	13	0.027	0.036	0.048	0.055	0.057	0.060	0.051	0.124	0.42
2PL1	6	7	9	9	10	12	0.033	0.038	0.049	0.049	0.054	0.064	0.049	0.144	0.34
2PL2	7	7	9	9	14	17	0.037	0.037	0.047	0.047	0.072	0.084	0.047	0.137	0.34
2PL3	10	10	11	11	12	13	0.056	0.056	0.062	0.062	0.067	0.072	0.062	0.140	0.44
2PL4	7	7	7	7	9	9	0.047	0.047	0.047	0.047	0.060	0.060	0.047	0.163	0.29
2PL5	5	7	7	9	13	16	0.033	0.045	0.045	0.058	0.083	0.098	0.052	0.158	0.33
3PL1	7	7	7	9	11	12	0.054	0.054	0.054	0.076	0.093	0.103	0.065	0.160	0.41
3PL2	5	7	8	8	9	9	0.022	0.035	0.044	0.044	0.054	0.054	0.044	0.151	0.29
3PL3	10	11	11	12	12	14	0.058	0.066	0.066	0.073	0.073	0.086	0.069	0.134	0.52
3PL4	5	7	7	8	8	12	0.037	0.059	0.059	0.069	0.069	0.113	0.064	0.178	0.36
3PL5	6	7	9	9	10	11	0.040	0.049	0.068	0.068	0.077	0.087	0.068	0.160	0.42
M1	6	6	7	7	7	7	0.035	0.035	0.041	0.041	0.041	0.041	0.041	0.158	0.26
M2	7	8	13	14	17	[a]	0.041	0.048	0.078	0.081	0.090	[a]	0.080	0.115	0.70
M3	5	5	6	6	7	7	0.032	0.032	0.041	0.041	0.050	0.050	0.041	0.166	0.25
M4	6	6	6	7	7	13	0.029	0.029	0.029	0.035	0.035	0.073	0.032	0.132	0.24
SL1	2	6	6	8	10	10	0.003	0.012	0.012	0.016	0.021	0.021	0.014	0.230	0.06
SL2	6	6	6	6	9	10	0.012	0.012	0.012	0.012	0.019	0.022	0.012	0.237	0.05

[a] No crack developed in this specimen.

a given mortar were prepared on any one day; the remainder of the specimens were made when the given mortar again came due in cyclical order.

Results and Discussion

The compressive strength, tensile bond strength, and water retentivity of the mortars are given in Table III. The strengths were determined for six specimens representing each mortar and three determinations of water retentivity were made for each mortar. The data on resistance of mortars to cracking are given in Table IV; six reinforced and three plain prisms were made for each of the test mortars.

Compressive Strength of Mortars:

It can be seen in Table III that the effect of kind of lime on the compressive strength of the portland cement-lime mortars was appreciable for groups 2PL and 3PL where, in each group, the spread of strengths was 18 per cent of the average, while for mortars of group 1PL the spread was only 6 per cent of the average strength.

Bond Strength of Mortars in Tension:

The average bond strengths with the various mortars were approximately 70 psi. for the group 1PL, 50 psi. for the group 2PL, 40 psi. for the groups 3PL and M, and 20 psi. for the group SL.

The large dispersion of data on bond strength shown in Table III is not uncommon in tests of this kind. A recent investigation by John W. Whittemore and Paul S. Dear[10] shows a range of coefficients of variation of from 8.5 to 75.7 per cent for tensile bond strengths of cross-brick specimens. However, J. C. Pearson[11] reported considerably more uniform results obtained with mechanically assembled tensile bond specimens, for which the coefficients of variation ranged from 8.3 to 14.8 per cent.

In an attempt to produce brick assemblages in which the joint would represent as nearly as possible continuous joints obtaining in brick walls, the authors had devised the 4-brick specimen illustrated in Fig. 1. The authors proceeded on the assumption that a mortar joint continuous across the bottom brick in the assemblage would minimize the extent of "edge effects," or zones of incomplete contact between brick and mortar, such as those described by J. W. McBurney[12] in his discussion of J. C. Pearson's paper. However, in view of the observed dispersion of data, the advantage of using a 4-brick assembly shown in Fig. 1 over the conventional 2-brick type of specimen is not apparent.

Water Retentivity of Mortars:

For a mix of given proportions, the water retentivity of portland cement-lime mortars was dependent primarily on the plasticity of limes used. It was observed that, generally, limes having high plasticity values produced mortars with high water retentivities. This observation thus confirmed previously obtained data for portland cement-lime mortars.[13] The plasticity values determined after the limes were soaked only 15 min. were somewhat more concordant with values of water retentivity than plasticity values obtained with limes that were soaked 18 hr. Water retentivities of lime-standard Ottawa sand mixes (1:3, by weight) also were indicative of the water retentivities of the portland cement-lime mortars into which limes were incorporated (Table II).

Resistance of Mortars to Cracking Effected by Shrinkage:

The shrinkage of plain mortar prisms exposed to air is shown graphically in Figs. 2, 3, and 4. The data are given for periods up to 6 months of drying and represent the average values of shrinkage for three prisms each of 21 mortars.

There was no consistent relation between the shrinkage of the various mortars and any of their other properties. However, for mortars of similar composition, such as the portland cement-lime mortars, the shrinkage increased roughly with the amount of mixing water required. Of these mortars, the minimum shrinkage was shown by the

[10] John W. Whittemore and Paul S. Dear, "Mortar Bond Characteristics of Virginia Brick," Bulletin No. 54, Virginia Polytechnic Institute, May, 1943.

[11] J. C. Pearson, "Measurement of Bond Between Bricks and Mortar," *Proceedings*, Am. Soc. Testing Mats., Vol. 43, p. 857 (1943).

[12] J. W. McBurney, Discussion of Pearson paper, *Proceedings*, Am. Soc. Testing Mats., Vol. 43, p. 867 (1943).

[13] Lansing S. Wells, Dana L. Bishop, and David Watstein, "Differences in Limes as Reflected in Certain Properties of Masonry Mortars," *Journal of Research*, Nat. Bureau Standards, Vol. 17, No. 6, December, 1936, *RP*952.

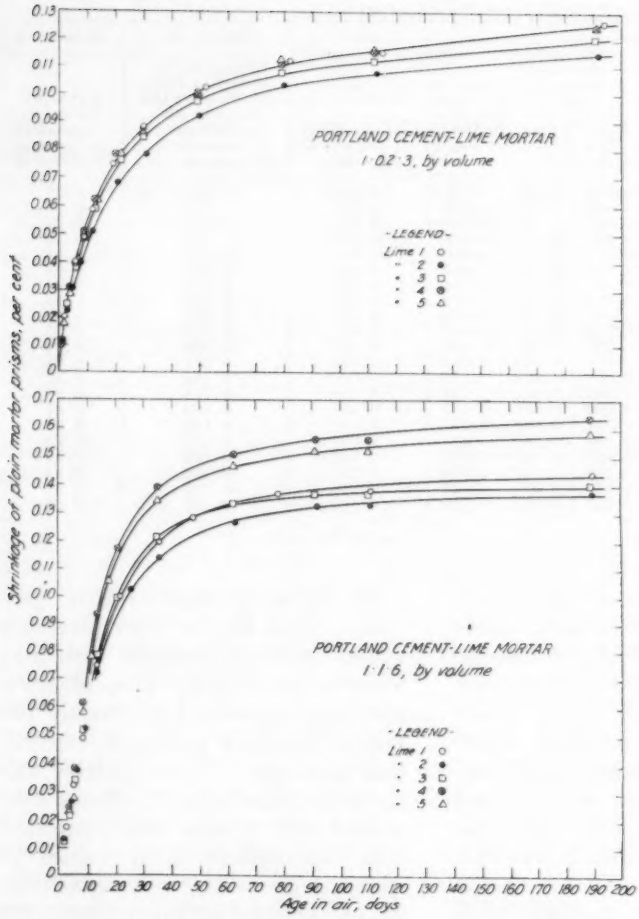


Fig. 2.—Shrinkage of Portland Cement-Lime Mortars (Groups 1PL and 2PL).

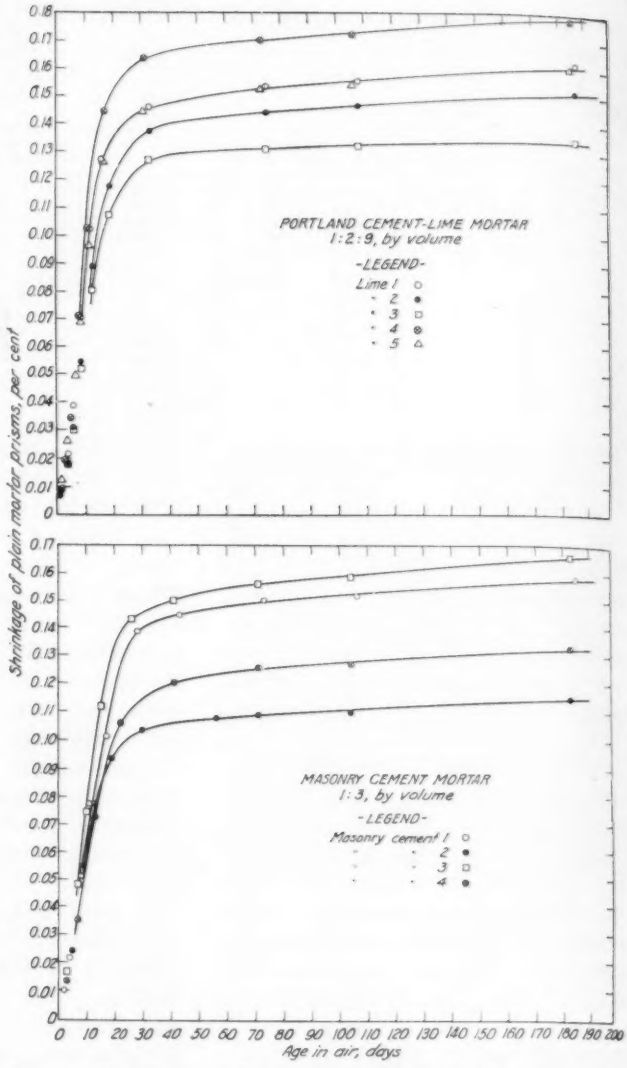


Fig. 3.—Shrinkage of Portland Cement-Lime Mortars (Group 3PL) and Masonry Cement Mortars (Group M)

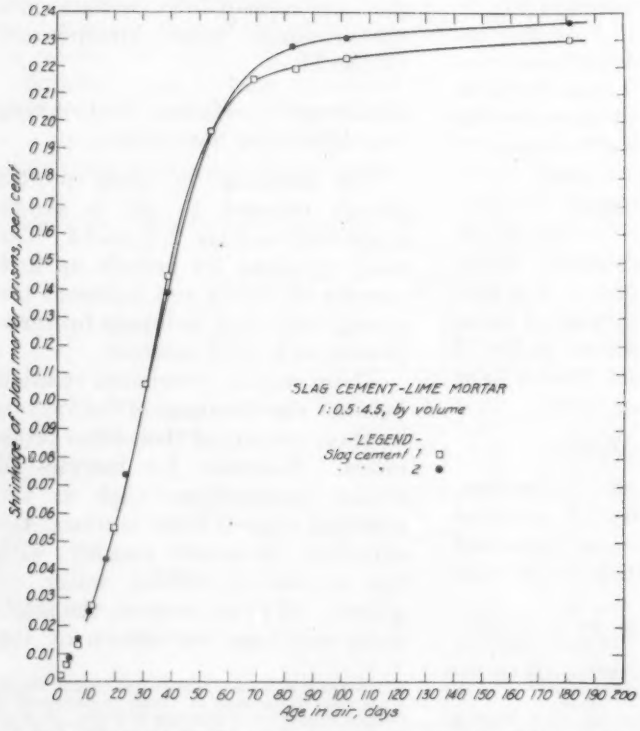


Fig. 4.—Shrinkage of Slag Cement-Lime Mortars (Group SL)

group 1PL, in which the average for five mortars, after 6 months' drying, was about 0.12 per cent. The range of values of shrinkage for the portland cement-lime mortars of groups 2PL and 3PL was considerably larger than in group 1PL, reflecting the correspondingly larger range in the amount of mixing water required by mortars in groups 2PL and 3PL.

The data on cracking of reinforced mortar prisms are given in Table IV. The length of storage of the reinforced prisms in air at the time of the appearance of the first shrinkage crack is given in column *A* of this table, while the shrinkage of the plain prisms at corresponding ages is given in column *B*. On account of the considerable dispersion of the data in column *B*, median rather

than average values of shrinkage for each group of six specimens are given in column *C*. The median values were taken as the averages of two central values in each group of six specimens arranged in ascending order in column *B*.

The ratios of the values in column *C* to the shrinkages observed in plain mortar prisms after 6 months' drying are given in column *E*. These values may be considered to be indices of the resistance of mortars to cracking effected by shrinkage, since they are the ratios of shrinkage present at the time of cracking to the "maximum" or "potential" shrinkage which might be expected with a given mortar, and therefore, the larger this ratio the less likely is the mortar in question to crack when restrained from shrinking freely.

As was the case with the shrinkage of mortars, no consistent relation between resistance to cracking and other properties of mortars was observed for the entire series of test mortars. For a group of mortars of comparable composition, such as the portland cement-lime mortars, the resistance to cracking increased, in general, with strength of the mortars and decreased with shrinkage. While the portland cement-lime mortars of group 1PL exhibited the highest resistance to cracking as a group, individual mortars of other groups showed resistance to cracking of the same, or higher, magnitude.

It was observed that some individual mortars exhibiting the highest shrinkage and least resistance to cracking developed the maximum number of tensile cracks in the reinforced prisms, this number ranging up to seven. Some prisms of these mortars also developed longitudinal cracks or networks of fine cracks in addition to transverse cracks.

Summary

1. The compressive strength of portland cement-lime mortars of group 1PL (1:0.2:3, by volume) was little affected by the type of lime used; the effect of various types of limes on the compressive strength of mortars became appreciable for groups 2PL and 3PL (1:1:6 and 1:2:9, by volume).

2. The average bond strengths with the various mortars were approximately 70 psi. for the group 1PL, 50 psi. for the group 2PL, 40 psi. for the groups 3PL and M, and 20 psi. for the group SL.

3. The shrinkage of mortars of comparable composition (portland cement-lime mortars) of any one proportion increased roughly with the amount of mixing water required by the mortars. The least shrinkage was observed with mortars of group 1PL.

4. The resistance of the mortars to cracking through shrinkage was rated by the ratio of the shrinkage of plain mortar prisms at the time of appearance of the first crack in reinforced prisms, to the shrinkage exhibited by plain prisms after 6 months' drying. The resistance to cracking increased, in general, with a decrease in shrinkage. For a group of mortars of comparable composition, the resistance to cracking increased, in general, with strength of the mortars and decreased with shrinkage. While the portland cement-lime mortars of group 1PL exhibited the highest resistance to cracking as a group, individual mortars of other groups possessed a resistance to cracking of the same, or higher, magnitude.

Micro Penetration of Lubricating Grease[1,2]

Report by Section II on Consistency Measurements and Related Physical Tests for Lubricating Greases, of Technical Committee G on Lubricating Grease, of Committee D-2 on Petroleum Products and Lubricants

Synopsis

A method of obtaining penetrations of small samples of grease of the order of 4 g. is discussed, which gives results of reasonable reproducibility. The apparatus is inexpensive, since it utilizes the present A.S.T.M. penetrometer and requires in addition only a simply constructed grease holder and an aluminum plunger and cone. The correlation between A.S.T.M. penetration values and results by the micro penetrometer is also given.

THE Tentative Method for Consistency of Lubricating Greases and Petrolatum (D 217 – 44 T)[3] requires that a considerable quantity of grease be available, that is, at least 400 to 500 g. for grease of soft or moderately soft consistencies. Although such quantities of grease are readily obtainable in the manufacturing plants or in storage, it frequently happens that information on the consistencies of very small samples of grease is desired. For example, after use on ball or roller bearings, such as the anti-friction bearings of motors, automobile wheels, industrial machines, etc., only relatively small quantities of worked or used grease adhere to the bearings. This amount of used grease is inadequate for actual measurements of consistency by the A.S.T.M. method.

In response to a questionnaire distributed by A.S.T.M. Technical Committee G, Section II, consumers and producers expressed the opinion that, in view of the above objection

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to A.S.T.M. Headquarters, 1916 Race St., Philadelphia 3, Pa.

[1] Presented at a meeting of Section II on Consistency Measurements and Related Physical Tests for Lubricating Greases, of Technical Committee G on Lubricating Grease, of Committee D-2 on Petroleum Products and Lubricants, Atlantic City, June 16, 1947.

[2] Report prepared under the direction of Gus Kaufman, The Texas Company, New York, N. Y.

[3] 1946 Book of A.S.T.M. Standards, Part III-A, p. 846.

to the A.S.T.M. method, a micro penetration method would be desirable. The Texas Company's micro penetration procedure[4] was chosen by Technical Committee G as the method for study since it was the only method in any extensive use and which required only small grease samples.

In developing procedures for determining consistencies of small quantities of semisolid materials such as lubricating greases, as expressed in terms of the depth of penetration of a plunger, the apparent solution has been to use a small penetrometer needle and a small holder for the grease in place of the present A.S.T.M. grease cone (6.51 cm. (2.56 in.) in diameter), and the rather large sized grease holder (453.6-g., 1-lb., tins are recommended).

Various types of small plungers such as glass rods of different weights have been used in order to reduce the size of the plunger cone. However, the chief difficulty involved in these cases has been suitable design of a small holder for the grease, since charging of a small cylinder with a semisolid material such as a lubricating grease causes air entrainment as well as working down of the grease structure and consequent alteration in consistency. These difficulties are overcome by using a split cylinder for the holder in the micro penetration procedure. Each half of the cylinder can be charged with grease by simply using a spatula. Thus working down of the grease is practically negligible and air entrainment is reduced to a minimum.

The penetrometer cone in the A.S.T.M. method, as stated above, has a maximum diameter of 6.51 cm. (2.56 in.), the total weight of cone and plunger being 150 g. In the case of the micro penetrometer, the size and weight of the plunger have been reduced by the use of an aluminum plunger and cone having a total weight of but 20 g. The small grease holder and plunger are then used in conjunction with the present A.S.T.M. grease penetrometer indicator.

[4] G. Kaufman, W. J. Finn, and R. J. Harrington, "Miniature Penetrometer for Determining Consistency of Lubricating Greases," *Industrial and Engineering Chemistry*, Anal. Ed., Vol. 2, p. 108 (1939).

Description of Apparatus and Procedure

A detailed description of the apparatus and procedure is given in the Appendix.

Experimental Data

In order to study the micro penetrometer cone and cup for penetration testing of very small grease samples, a cooperative testing program was initiated. It was requested that both unworked and worked penetrations at 77 F. be run. Unworked penetration was taken to be the result obtained after the grease was transferred from the original container to the micro test cup with a minimum of working. Worked penetration was understood to be the result obtained after transferring the sample from the A.S.T.M. worker cup, after 60 strokes working, to the micro cup. Twelve laboratories submitted data and four laboratories ran repeat tests, making a total of sixteen sets of data on each of the following four greases:

1. Aluminum-base grease,
2. Calcium-base grease,
3. Soda-base grease, and
4. Soda-base grease made with high-viscosity oil.

A summary of the results of this testing is shown in Table I. It may be noted that reproducibility in the case of grease No. 1 (365 unworked A.S.T.M. penetration) was very poor. With greases Nos. 2, 3, and 4, reproducibility was indicated to be quite good, but the low order of penetration readings is noteworthy.

Since the test reproducibility on grease No. 1 in this first testing program was not considered very satisfactory and because it was believed better reproducibility should be obtained on all samples, a second cooperative testing program was set up. Ten laboratories participated in the testing of four reference greases. Tests were run at 77 ± 3 F., the sample receiving no working other than that involved in transferring the grease from the sample cans to the micro cup.

Micro penetration values obtained by these laboratories are shown in Table II. Penetration results in this case were quite similar to those obtained in the previous cooperative program and indicated that the micro penetration method is reasonably reproducible between laboratories with greases of quite stiff consistency, but not very satisfactory with softer greases.

Due to the belief that the degree of test reproducibility had been greatly influenced in the previous testing by variations in weights of the micro cone and shaft as well as possible variations in testing procedures, it was agreed that a micro

TABLE I.—COOPERATIVE MICRO PENETRATIONS (FIRST PROGRAM).

	Grease 1		Grease 2		Grease 3		Grease 4	
	Unworked	Worked	Unworked	Worked	Unworked	Worked	Unworked	Worked
Average	300	365	150	155	60	85	60	70
Maximum	339	397	167	165	67	92	69	86
Minimum	250	329	136	146	52	71	52	59
Spread	89	68	31	19	17	21	17	27

TABLE II.—COOPERATIVE MICRO PENETRATION (SECOND PROGRAM) (UNWORKED PENETRATIONS AT 77 ± 3 F.).

Laboratory	Grease 5	Grease 6	Grease 7	Grease 8
1	94	138	220	145
2	104	139	235	150
3	113	142	236	146
	106	150	234	152
4	108	150	244	165
5	133[a]	172[a]	288[a]	202[a]
	104	143	258	163
6	117	148	262	179
	104	141	261	171
7	199[a]	314[a]	444[a]	301[a]
	220[a]	336[a]		
8	103	142	240	148
9	99	138	231	146
10	99	137	210	139
11	99	137	225	163
Summation				
Average	105	143	238	155
Maximum	117	150	262	179
Minimum	94	137	210	139
Spread	23	13	52	40

[a] Omitted from summations. Large deviation from other laboratories considered to be due to incorrect weight of micro cone and shaft or other such instrument variation.

TABLE III.—COOPERATIVE MICRO PENETRATIONS (CLINIC TESTING) (WORKED PENETRATION AT 78 F.).

Grease	9	10	11	12	13
Average	186	77	87	63	146
Maximum	191	79	89	64	152
Minimum	178	74	82	62	139
Spread	13	5	7	2	13

penetrometer "clinic" should be held where all cooperators would be present at one time, thereby being better able to determine possible causes for differences in results. Accordingly, representatives from four laboratories participated in testing five reference greases under very closely controlled conditions. All tests were run on the worked grease in a constant temperature room (78 F.) with all operators using the same micro penetrometer and A.S.T.M. worker. Greases tested were as follows:

9. Calcium-base grease,
10. Calcium-base grease,
11. Soda-base grease,
12. Soda-base grease, and
13. Mixed base lime-soda grease containing low-viscosity oil.

Table III gives a summary of the penetration values obtained at the micro penetrometer "clinic." The reproducibility in the case of grease No. 12, the one of lowest consistency, was ±2 points while the reproducibility was ±7 points in the case of grease No. 9, the one of highest consistency (maximum value of 191). Thus, the numerical value representing the reproducibility becomes increasingly larger (poorer reproducibility) as the consistency of the grease being tested increases. This same relationship of decreasing reproducibility of the test method with increasing grease consistency existed throughout the cooperative testing. Thus, it may be concluded that a reproducibility of ±7 points may be expected with the micro penetration procedure on greases having a micro penetration of 200 or less. On greases of lower consistency, better reproducibility may be expected.

Since the ultimate usefulness of the micro penetration method depends to a large extent on reasonably accurate correlation with standard 150-g. cone penetrations, it was desired to accumulate as many data as possible on comparisons of micro with standard penetrations. It was therefore requested that during the cooperative testing the cooperating laboratories supply test comparisons on greases of various consistencies and types. From these data, a curve showing the relation of the micro penetrometer tests to standard 150-g. cone tests for a large variety of greases was constructed and is shown in Fig. 1.

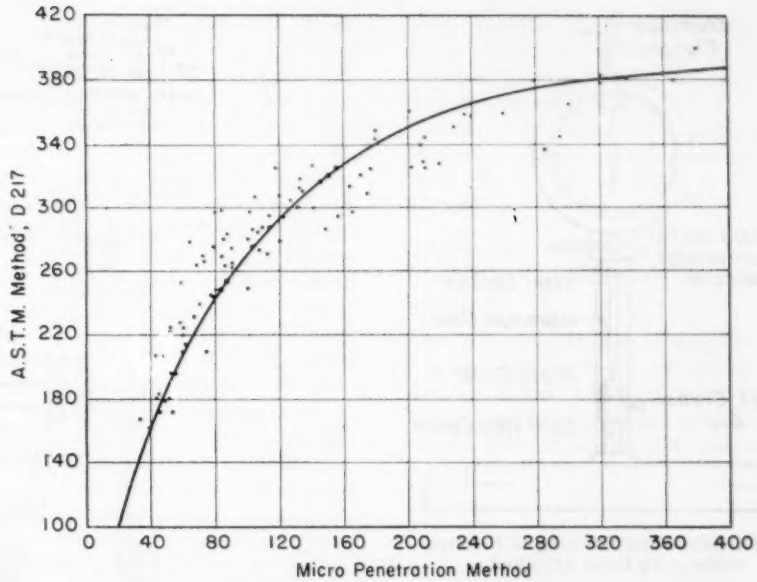


Fig. 1.—Comparison of A.S.T.M. Consistency versus Micro Penetration Method.

Each point plotted represents a different grease and covers practically all types and varieties of grease as to soap base and mineral oil constituent.

Summary

The micro penetrometer permits consistency measurements on small samples of grease—that is, about 3 to 5 g. Usually more than this quantity of used grease can be readily recovered from antifriction bearings of average size. The micro penetrometer also allows check determinations with a small supply of sample and fairly consistent check results are possible on the same sample of used grease.

The micro penetration procedure can be considered satisfactorily reproducible. With greases showing about 200 micropenetration (approximately 350 A.S.T.M. penetration) the reproducibility is ±7 points and is even better at lower penetrations.

APPENDIX

Method of Test for Micro Penetration of Lubricating Grease[1]

Scope

1. (*a*) This method of test is intended for the measurement of the penetration of lubricating greases as an empirical measure of consistency where the quantity of grease available is too small for consistency measurements by A.S.T.M. Method D 217, Test for Consistency of Lubricating Greases and Petrolatum.[2] The values obtained are a purely arbitrary evaluation of consistency and it is imperative that test conditions be adhered to in detail. The test is applicable to greases having micro penetration up to 200. The method contains two procedures as follows:

Procedure A, for penetration of worked lubricating greases (Note 1), and

Procedure B, for penetration of unworked lubricating greases.

Note 1.—Although this method is intended primarily for penetration tests on very small samples, the procedure for worked penetration is included since a comparison of the worked consistency of the unused grease with the consistency of small fractions of grease, obtained from different locations on test devices employing ball or roller bearings, is sometimes desired.

(*b*) Unworked penetrations are affected

[1] G. Kaufman, W. J. Fine, and R. J. Harrington, "Miniature Penetrometer for Determining the Consistency of Lubricating Greases," *Industrial and Engineering Chemistry*, Anal. Ed., Vol. 2, p. 108 (1939).

[2] 1946 Book of A.S.T.M. Standards, Part III-A, p. 846.

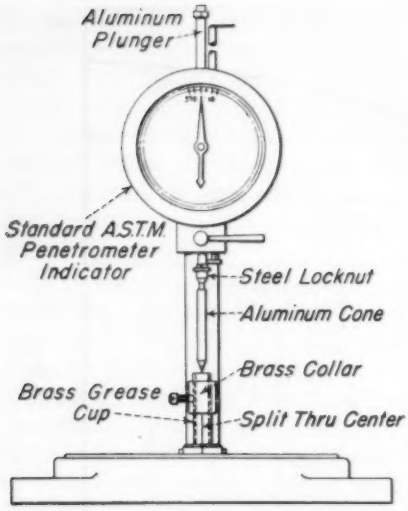


Fig. 2.—Schematic Drawing of Penetrometer with Cone Attached.

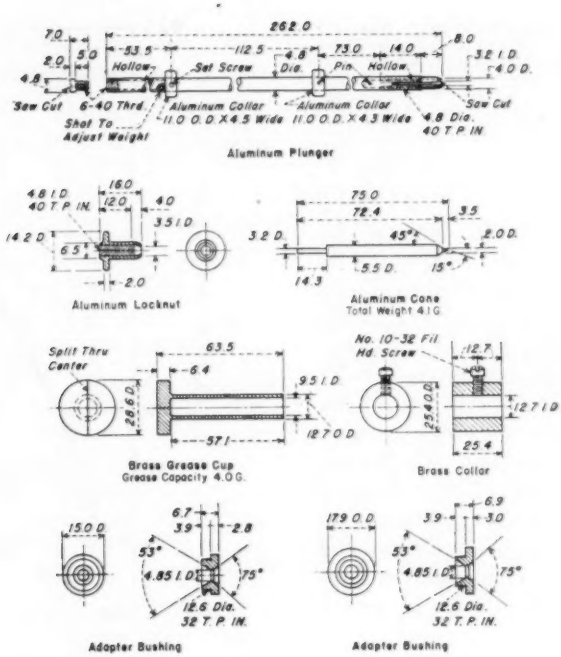


Fig. 3.—Schematic Drawing of Aluminum Cone Set.

All dimensions are in millimeters.

by a number of factors which are difficult to control (Note 2), and do not generally represent the consistency of grease in use as effectively as worked penetrations which should therefore be preferred for evaluating lubricating grease, wherever practicable.

NOTE 2.—The unworked penetration of a grease may not be a reliable measure of its consistency in its original state of manufacture. Any transferring or other manipulating of grease subsequent to manufacture tends to affect the unworked penetration by amounts depending on the type of the grease and the handling it is given. The term "work" is used herein to denote the intentional altering of the consistency of a grease by subjecting it to 60 strokes of the specified worker.

Definitions

2. For the purpose of this method, the following definitions will apply:

(*a*) *Penetration* is the distance in tenths of a millimeter, which the micro cone, under the specified conditions of the method, will penetrate a lubricating grease in 5 sec. A single determination of penetration will be referred to as a "test."

(*b*) *Worked Penetration* is the penetration of a sample of grease immediately after transferring it to the micro cup from the grease worker where it has been brought to 77 F. and subjected to 60 strokes of the specified grease worker.

(*c*) *Unworked Penetration* is the penetration at 77 F. of a sample of lubricating grease after the grease, which has not been subjected to the action of the grease worker, has been transferred from the original container to the micro test cup with a minimum of working.

Apparatus

3. The apparatus shall consist of the following:

(*a*) *Penetrometer.*—An instrument for applying the specified cone to the surface of the sample and for measuring the penetration distance at the conclusion of the test. It shall be so constructed that it permits (by means of a slow-motion adjustment) the accurate placement of the tip of the cone adjoining the level surface of the sample while maintaining a "zero" reading on the indicator, and that it permits the cone to fall, when released, without appreciable friction. The instrument shall be provided with leveling screws and a spirit level to maintain the cone shaft in a true vertical position. A simplified sketch of such a penetrometer with cone attached is shown in Fig. 2.

(*b*) *Micro Cone Set.*[3]—An aluminum micro cone set consisting of a cone, plunger with collars and locknut conforming to the dimensions shown in Fig. 3. The outer surface of the cone and tip shall be given a very smooth finish. The weight of the cone shall be 5 g. The combined weight

[3] The micro cone set is available from Precision Scientific Co., Chicago, Ill.

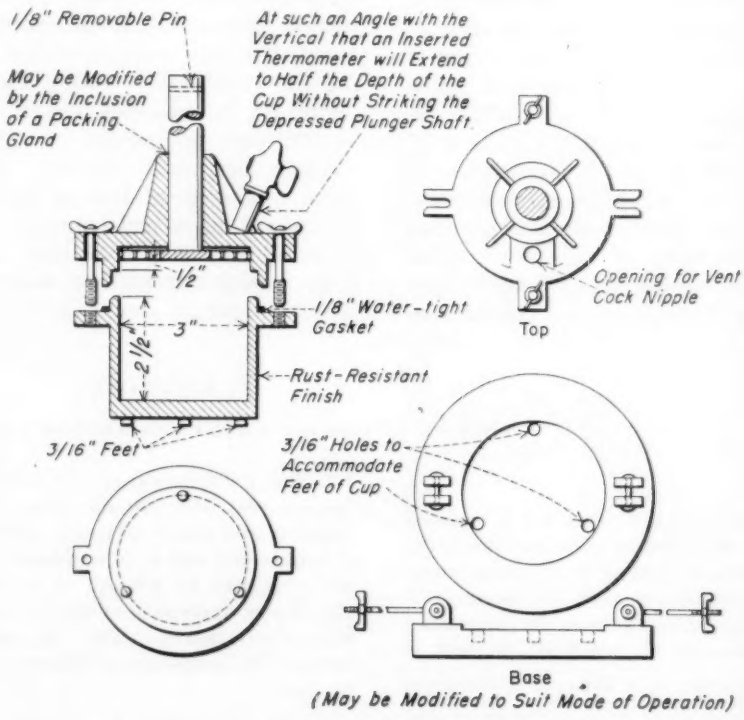

1/8" Removable Pin
May be Modified by the Inclusion of a Packing Gland
At such an Angle with the Vertical that an Inserted Thermometer will Extend to Half the Depth of the Cup Without Striking the Depressed Plunger Shaft
1/2"
3"
2 1/2"
1/8" Water-tight Gasket
Rust-Resistant Finish
3/16" Feet
Top
Opening for Vent Cock Nipple
3/16" Holes to Accommodate Feet of Cup
Base
(May be Modified to Suit Mode of Operation)

Fig. 4.—Grease Worker.

of the plunger and locknut shall be 15 g.

(*c*) *Grease Cup.*—The grease cup shall consist of a split brass bushing affixed to a suitable base and a brass collar with set screw for holding the two valves together as shown in Fig. 3. This grease cup has a capacity of approximately 4 g. of grease but smaller amounts can be evaluated, if the grease is not too soft, by using wooden plugs to fill the lower part of the cup.

(*d*) *Grease Worker.*—A worker, as shown in Fig. 4, provided with a movable bimetallic thermometer of short scale range including 77 F., for inserting through the vent cock. Alternative methods of closure to that shown in Fig. 4 or other details of the exterior of the worker shall be permitted, provided such changes do not adversely affect the operability of the worker. The worker may be operated either manually or mechanically, provided a rate of about 60 strokes per minute can be obtained.

(*e*) *Constant-Temperature Bath.*—A constant-temperature testing room or an air bath capable of regulation to 77 ± 1 F.

(*f*) *Spatula.*—A spatula, of corrosion-resistant steel, having a stiff blade 1¼ in. in width and at least 6 in. in length with its end cut on the square.

Procedure A. Penetration of Worked Lubricating Grease (Note 1)

Sample

4. The sample for worked penetration shall be of sufficient size to overfill the cup of the specified grease worker by an amount such that the cup will be at least level full after working. At least 1 lb. will be required.

Procedure

5. (*a*) Transfer sufficient of the sample to the cup of the clean grease worker to fill it heaping full (mounded up about ½ in. at the center), avoiding the occlusion of air by packing with the spatula. Assemble the worker, open the vent cock, depress the plunger to the bottom, and insert through the vent cock a suitable thermometer so that its tip is in the center of the grease. Place the assembled worker and the grease cup in the 77 F. air bath until the temperature of the worker and contents and the grease cup is 77 ± 1 F. as indicated by the thermometer. Then remove the worker from the bath and remove the thermometer and close the vent cock. Subject the grease to 60 *full* double strokes of the plunger, completed in approximately 1 min., and return the plunger to its top position. Open the vent cock and remove the top and plunger. As the penetration of a worked lubricating grease may change significantly on standing, it is imperative that the operations described in Sections 5(*b*) to (*e*) be performed without delay.

(*b*) By means of a spatula transfer the worked grease to the small grease holder, filling each half of the split cylinder and taking care that air pockets are avoided. Then clamp the two halves together by means of the brass collar as indicated in Fig. 2. Replace the grease cup in the bath for a sufficient time (approximately 20 min.) to compensate for any slight change in temperature during the filling period. Scrape off the excess grease extending above the brim of the cup by moving the blade of the spatula, held inclined toward the direction of motion at an angle of 45 deg., across the brim of the cup.

(*c*) Place the cup on the penetrometer table. Observe that the cone is in its "zero" position, and lower as a unit the cone and indicator assembly until the cone tip nearly touches the surface of the sample at a point as exactly as possible at the center of the cup. Securely lock the cone and indicator assembly in position, and bring the cone tip down to just touch the surface of the sample by means of the slow-motion adjustment. Operating the release mechanism rapidly, release the cone shaft and hold it free for exactly 5 sec., observing that the release mechanism does not drag on the shaft. Then gently depress the indicator shaft until it is stopped by the cone shaft and read the penetration from the indicator scale.

(*d*) Following each test, clean the penetrometer cone by wiping it carefully with a clean cloth while holding it securely in its raised position (to avoid bending its shaft). Rotating the cone is to be discouraged, as it may cause wear on the release mechanism.

(*e*) If check results are desired, add a new supply of grease to the grease cup and repeat the test as described in Sections 5(*b*) and (*c*).

Procedure B. Penetration of Unworked Lubricating Greases

Sample

6. A sample of grease of approximately 4 g. is required to fill the grease cup. However, a smaller amount may be evaluated, if the grease is not too soft, by using wooden plugs to fill the lower part of the cup.

Procedure

7. (*a*) Place the sample and grease cup in the bath and bring to 77 ± 1 F. Then transfer the grease to the grease cup by means of a spatula, filling each half of the split cylinder and taking care that air pockets are avoided. Then clamp the two halves together by means of the brass collar as indicated in Fig. 2. Replace the grease cup in the bath for a sufficient time (approximately 20 min.) to compensate for any slight change in temperature during the filling period. Scrape off the excess grease extending above the brim of the cup by moving the blade of the spatula, held inclined toward the direction of motion at an angle of 45 deg., across the brim of the cup.

(*b*) Determine the penetration of the sample as described in Sections 5(*c*) and (*d*).

(*c*) If check determinations are desired and enough grease sample is available, repeat the test with a new sample as described in Sections 7(*a*) and (*b*). If insufficient sample is available for the second test, another penetration may be made on the sample in the grease cup.

Reproducibility

8. The reproducibility of the procedures described in this method should be ± 7 points.

A Microworker for Lubricating Greases[1]*

By George M. Hain[2]

Synopsis

A new instrument is described for mechanically working 5-g. samples of lubricating greases and for measuring the consistency of these greases at any stage of the working process. It consists of two 5-cu. cm. hypodermic syringes connected together tip to tip through a shearing element. The technique used for measuring consistency is the conventional micropenetrometer needle with a novel cup for holding the grease. Whereas the present 100,000-stroke test in an A.S.T.M. worker requires over 24 hr., the same information can be obtained on most greases in about 10 min. using the new microworker. This new method of testing greases greatly expedites the evaluation of mechanical stabilities and makes probable significant advances in the development and specification of greases.

A Tentative Method D 217 – 44 T[3] describes a method for measuring the consistency of petroleum greases. Part of this test requires that a sample of approximately one pound be worked 60 cycles in a mechanical worker which squeezes the grease back and forth through a plate perforated with $\frac{1}{4}$-in. holes. Sixty strokes was adopted because practice showed that most commonly manufactured greases did not soften much further with additional working. These greases were the conventional kettle-made greases which are manufactured by cutting back a stiff oil and soap paste with additional oil. The grease is paddled continuously and cooled somewhat during the cutback process. The mechanical worker needs only to break down the structure formed in the cooling which takes place after the grease is packaged.

During the war, however, lithium soap grease in large quantities was manufactured for the Army and Navy by the fire kettle procedure. The rigid gel formed on cooling without agitation was often only partially worked before packaging. Therefore, the standard 60-stroke penetration proved unreliable in predicting the performance of these greases in the bearings of high-speed motors. Army and Navy agencies have done considerable work in determining the mechanical stability or the extent of softening in greases when they are worked in the conventional worker to a million or more cycles. For much of this work a micropenetrometer suggested by Kaufman, Finn, and Harrington[4] had been used to measure the consistencies, but no instrument for working a small sample of the grease has been proposed. For much experimental work, expecially in the field of synthetic fluid base lubricants, the size of sample required by the A.S.T.M. test, or modifications of it, is prohibitive. The A.S.T.M. test is also slow since only one test per day can be run in the automatic grease workers used in the 100,000-stroke test. The microworker described here permits much more rapid determinations on a 5-g. sample.

The new worker (see Fig. 1) consists of two 5-cu. cm. hypodermic syringes locked together tip to tip through a shearing element *E*. The shearing element consists of two cut-off hypodermic needle hubs soldered together with a fine mesh screen

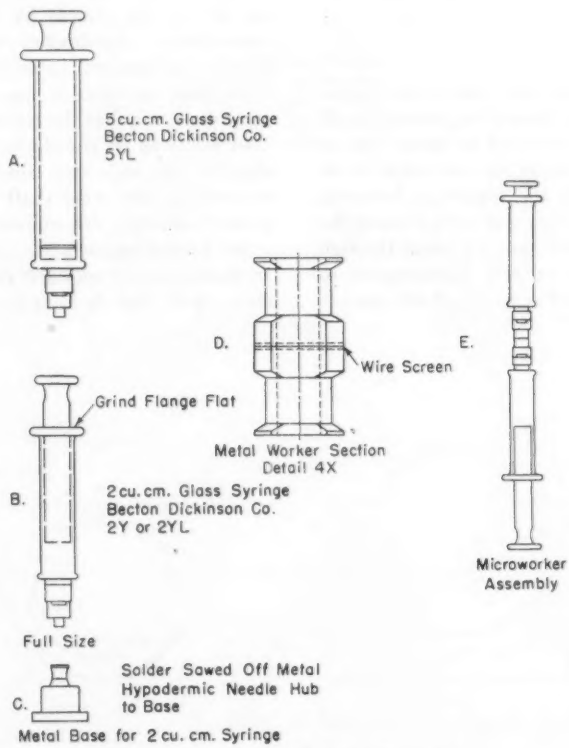


Fig. 1.—Microworker for Greases.

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to A.S.T.M. Headquarters, 1916 Race St., Philadelphia 3, Pa.

* Presented at a meeting of Section II on Consistency Measurements and Related Physical Tests for Lubricating Greases, of Technical Committee G on Lubricating Grease, of Committee D-2 on Petroleum Products and Lubricants, Atlantic City, June 16, 1947.

[1] The opinions or assertions in this paper are the author's and are not to be construed as official or reflecting the views of the Navy Department.

[2] Naval Research Laboratory, Washington, D. C.

[3] Tentative Method of Test for Consistency of Lubricating Grease and Petroleum (D 217–44 T), 1946 Book of A.S.T.M. Standards, Part II-A, p. 846.

[4] G. Kaufman, W. D. Finn, and R. J. Harrington, "Miniature Penetrometer for Determining the Consistency of Lubricating Greases," *Industrial and Engineering Chemistry*, Anal. Ed., Vol. 11, p. 108 (1939).

[This penetrometer is described in this issue of the ASTM Bulletin in the Appendix to the report by G. Kaufman on Micro Penetration of Lubricating Grease, see p. 81. Ed.]

TABLE I.—EFFECT OF WORKING IN MICROWORKER.

Grease	Micropenetrations after Following Number of Passes			
	Unworked	1	10	100
	250 Mesh Screen			
No. 3..	52	54	53	60
No. 4..	86	92	92	110
No. 5..	59	67	126	324
No. 2..	90	110	176	350
	60 Mesh Screen			
No. 2..	90	103	140	243

across the joint as shown in *D*. The lock-type syringe manufactured by Becton, Dickinson & Co. (Yale-Lok 5YL) is recommended because the lock tip prevents tip breakage and makes a rigid assembly which cannot fly apart when pressure is applied. The plunger is removed from one of the 5-cu. cm. syringes, and a solid plug of grease is pulled into it through the base by applying suction to the tip. The excess grease is then pushed out through the tip with the plunger, and the worker section and second syringe assembled as shown in Fig. 1-*E* with the plunger of the second syringe all the way down. The grease is pushed through the worker section into the second syringe. A No. 10 rubber stopper is a convenient support against which to press the plunger. The consistency of the grease after any number of passes through the screen is measured as follows: The tip of a 2-cu. cm. syringe (Fig. 1-*B*) is attached through an adapter to the tip of the 5-cu. cm. syringe, and the grease is forced in until the 2-cu. cm. syringe plunger is expelled. The 2-cu. cm. syringe is mounted in base *C* to measure the penetration. The Becton, Dickinson & Co. syringe 2Y or 2YL has internal dimensions nearly the same as the Kaufman micropenetrometer cup. The micropenetrometer cone is used for all consistency measurements. After the penetration is measured, the grease may be forced back into the 5-cu. cm. worker again. The syringe-to-syringe adapter is the same as the worker section *D* except that there is no screen between the needle hubs.

The object of the worker is to break down aggregates of flocculated individual soap crystals and also the continuous sponge-like structures of soap fibers. Large holes are unsuited to the latter process, although the shearing forces set up by flow through these holes is usually sufficient to break down loosely flocculated aggregates. When a wire screen is substituted for the perforated plate, each wire acts as a cheese cutter cutting through the rigid gel particles, and the shearing forces set up by flow through fine holes gradually breaks down these gel islands into individual fibers, a fact easily demonstrated by the dark field microscope. Fine screens are not possible in the conventional grease worker because the pressure per unit area is not high enough. With hypodermic syringes a pressure of 150 psi. is easily attained.

With a 400-mesh screen (0.0010-in. diameter wire) the microworker is suitable for lump-free greases as stiff as 240 A.S.T.M. penetration. However, when greases as stiff as these are worked, the screen should be examined frequently and replaced as soon as one or more of the wires break at the edge in fatigue failure. Monel or corrosion-resistant steel wire mesh in the range of 60 to 250 meshes per inch is suitable for greases stiffer than 240 A.S.T.M. penetration. The finest screen commercially available is 400 mesh screen from the Newark Wire Cloth Co. Although 1000 by 120 mesh woven cloth is also available, the open area is so much smaller in proportion to the total plate area that lumps tend to be held back until a solid cake is formed. For stiff greases, syringes of smaller bore size permit higher working pressures. Screens of mesh as coarse as 60 are useful for very stiff greases since the pressure required is considerably less than for a 250 or 400 mesh screen.

TABLE II.—EFFECT OF 100,000 STROKES IN A.S.T.M. WORKER (SAME GREASES AS IN TABLE I).

Grease	A.S.T.M. Penetrations after Following Number of Passes		
	60 ¼-in. Holes	100,000 ¼-in. Holes	100,000 1/16-in. Holes
No. 3....	188	238	...
No. 4....	266	363	...
No. 5....	290	370	400+
No. 2....	313	400+	...

The microworker works the grease in a sealed system so that no air is drawn in during the process. Another advantage lies in the small cross-section, so that the whole apparatus can be placed for a few minutes in a water bath to bring the grease to the correct testing temperature. This has been a tedious process with the standard worker because of the slow heat transfer through a large mass of grease.

Table I gives the results obtained with the microworker. In Table II are given for comparison the measurements on the same greases obtained at the Engineering Experimental Station, Annapolis, Md., using 100,000 strokes in the A.S.T.M. worker in terms of A.S.T.M. penetrations. The data of Tables I and II show that the microworker evaluates the greases in the same order as the tedious standard procedure. The micropenetrations are difficult to correlate with A.S.T.M. penetrations when different types of greases are involved, so no attempt has been made to convert between the two systems.

Data obtained on lithium soap diester greases[5] show that the breakdown after 1 to 500 passes through a 400 mesh screen is permanent, even after so long a waiting period as 6 weeks. There is some apparent recovery if the Kaufman split cup is used for the penetration test, but this disappears when the grease is agitated in transferring it from a large syringe to the 2-cu. cm. measuring syringe.

The greatest contribution of the microworker is in showing the effect of rust inhibitors, free acidity, or other polar impurities on the work stability of a grease. In Table III all the greases have the same soap content and substantially the same fluid base except for additives and impurities. The fluid in all cases is di-2-ethyl-hexyl sebacate, and the soap is lithium stearate. Grease A was made from the crude diester which had been freed of polar impurities by adsorption methods. Grease B was made from the same purified diester, but contained 2 per cent of sorbitan monoleate as a

[5] G. M. Hain, D. T. Jones, R. L. Merker, and W. A. Zisman, "Synthetic Low-Temperature Greases from Aliphatic Diesters," *Industrial and Engineering Chemistry*, Vol. 39, p. 500 (1947).

TABLE III.—USE OF MICROWORKER TO EVALUATE THE EFFECT OF ADDITIVES ON SHEAR STABILITY.

Grease	Micropenetrations after Following Number of Passes Through 400 Mesh Screen			
	Unworked	1	10	100
No. A..	74	81	89	100
No. B..	116	142	177	214
No. C..	125	135	164	230

Note.—In processing, these greases had already been passed eleven times through a 70 by 80 mesh wire cloth.

rust inhibitor. Grease C was made from the crude diester but was otherwise identical with grease A.

In addition, the grease worker has many experimental uses because of the intense mixing it accomplishes. It is, in effect, a miniature mixing kettle. It can be used to test the effect of small quantities of additives such as water, antioxidants, or rust inhibitors on experimental greases. The device is useful for making experimental cutbacks to determine the effect of soap content on consistency and for making grease dispersions of the high dilutions necessary for microscopic examinations of grease structure under dark field conditions.

Conclusions

The new microworker is a valuable device for the development and evaluation of greases because it permits rapid determination of the relative work softening of a grease on a very small sample. Results may be obtained in a few hours on a large number of samples which would take weeks to evaluate by any other known procedure. Its ability to mix the additives and filter the greases should also prove useful.

Discussion of Paper on Outdoor Exposure of Filled Asphalt Coatings[1]

The following discussion was submitted after publication of paper and discussion in the January ASTM Bulletin.—Ed.

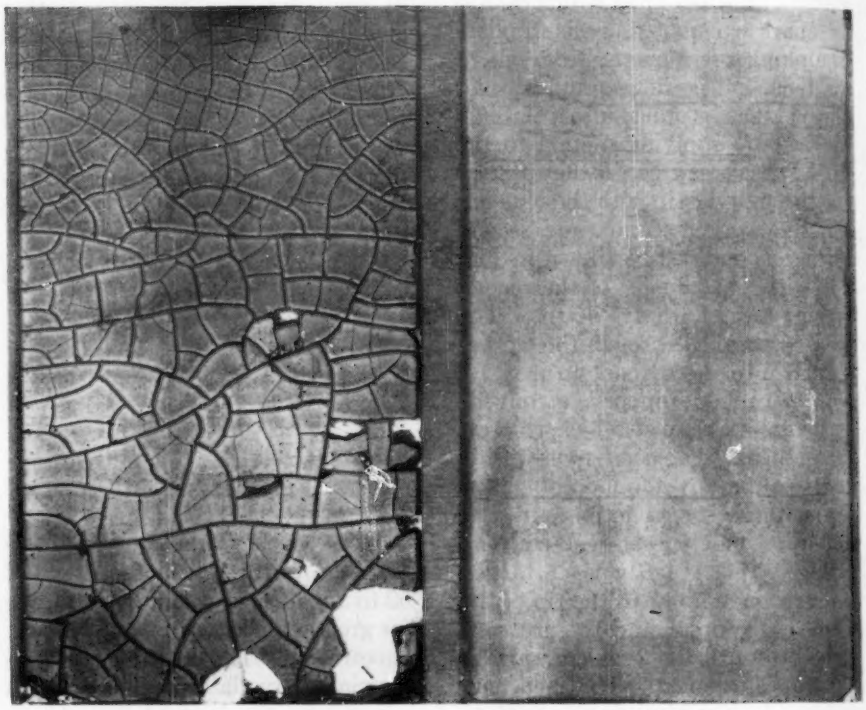
Mr. Milton R. Beasley.[2]—

Through the courtesy of the Flintkote Co., two panels of Filled and Unfilled asphalt coating which have been exposed on a test deck for five years are shown in Fig. 7. Both of these coatings were prepared from the same Venezuelan asphalt and exposed on metal. The thickness of coating film in each case was purposely varied from 0.005 to 0.125 in. The physical characteristics of these coatings are as follows:

Unfilled Coating—Softening Point—225 F., Penetration 100 g., 5 sec., 77 F.-16.

Filled Coating—(45 per cent blue-black slate flour)—Softening Point—222 F. Penetration, 100 g., 5 sec., 77 F.-16.

It is interesting to note the difference in cracking due to variation in coating thickness and the excellent weathering of the filled coating as compared to the almost complete failure of the unfilled coating.



Unfilled 45 per cent Blue-Black Slate Flour

Fig. 7.—Venezuelan Coating Exposed 5 yr. at Rutherford.

Mr. G. L. Oliensis (*author's closure*).—The fact that in these two metal panels (No. 7) the filler used was again blue-black slate flour, serves to accentuate still further the point I made in my original closure, to wit: that with only a single unimportant exception, all the many panels and graphs submitted by Messrs. Beasley and Cubberley are based on the use of only blue-black slate flour—that relatively rare and specially efficient filler, and in not a single set or graph have any of the much more commonly used fillers of the roofing industry been included. This, I submit, makes the evidence they advance rather patently one-sided. As to the widening and deepening pattern of cracks developed in coating as the layer thickness of the latter increases, this corroborates my own findings during actual exposure both in unfilled and filled coatings, as brought out in the first paragraph of my paper and illustrated so graphically in my Figs. 1 and 2.

[1] G. L. Oliensis, "Ten Years' Outdoor Exposure of Filled Asphalt Coatings on Saturated Felts," ASTM Bulletin, No. 144, January, 1947.

[2] Consulting Chemist, Norwood, Mass.

Discussion of Paper on Reproducibility of the Single-Blow Charpy Notched-Bar Test[1,2]

Mr. L. D. Jaffe.[3]—A reproducibility study of Charpy test has clearly been needed, and the authors are to be complimented on having undertaken it. It is unfortunate that in the interlaboratory experiments the V-notch specimens were within the transition-temperature range while the keyhole notch specimens were above this range, making comparison impossible.

The authors conclude, from Fig.

[1] N. A. Kahn and E. A. Imbembo, "Reproducibility of the Single-Blow Charpy Notched-Bar Test," ASTM Bulletin, No. 146, May, 1947, p. 66.

[2] The statements contained herein are those of the discusser, and do not necessarily represent the views of the Ordnance Department.

[3] Watertown Arsenal, Watertown, Mass.

8, that the transition zone is more sharply defined by the keyhole specimen than by the V-notch. This conclusion seems justifiable when, as in the authors' measurements, many specimens are tested at each temperature. Often it is not practical to test more than two or even one specimen at each temperature. Figure 8 shows that the transition curve for V-notch specimens would still be defined reasonably well. For keyhole specimens it would be a matter of chance, depending on a single specimen, whether the apparent abrupt transition was at 0 or 40 F.

Consider also a specification in which two Charpy specimens are tested at one temperature only. The test will be important only when this temperature is in the transition zone. In this case, both V-notch specimens would show values intermediate between low and high, and acceptance would depend on how the transition curve lay with respect to the test temperature. With two keyhole specimens and a single test temperature, high or low values or one of each would be obtained, depending only on chance, and not on the position of the transition curve. (Remember that the test temperature is here assumed to be somewhere within the transition zone.)

MESSRS. N. A. KAHN AND E. A. IMBEMBO (*authors' closure by letter*).[4]—The authors are in agreement with Mr. Jaffe that the reproducibility tests would have afforded a more clear-cut comparison had the temperature of test been above the transition zone of the material. On the basis of Fig. 8, the data for which were unfortunately not available at the time the reproducibility tests were started, this temperature would be above 100 F. Room temperature had been selected for simplicity in testing on the part of the cooperators. However, it is felt that lack of reproducibility in the V-notch test results is evident from the fact that graph I, Fig. 6, shows a general inclination in the plotted results from one laboratory to the next, which is attributed to lack of reproducibility in the notch; the vertical spread in the results is attributed to transition zone influences which, if the notch were reproducible, should have been evident in the results of tests on specimens submitted by all laboratories.

The authors cannot agree with Mr. Jaffe that any positive interpretation may be given to Charpy notched-bar tests when single specimens are tested at each temperature. The transition region is by nature one of great scatter in the energy values and single specimen tests would be completely inadequate in accurately defining the location of this zone. Hence, conclusions derived from a single specimen series may prove misleading.

Mr. Jaffe states that when two keyhole-notch specimens are tested at one temperature within the transition zone, high or low values or one of each might be obtained, with which we agree. He also states that V-notched specimens tested under the same conditions would give values intermediate between high and low, the reasons for which we fail to see if he is referring to the high and low values which would be revealed at the temperature of test if a large number of specimens had been tested. With the test temperature within the transition zone of the material investigated, say at a temperature of 80 F., V-notched specimens 2 and 3 (Table VI) broke at 61.0 and 31.5 ft-lb., respectively. How can one attach greater significance to these two values than to two keyhole values (Nos. 2 and 3) of 7.0 and 30.5 ft-lb. respectively obtained at 20 F.?

[4] The statements contained herein are those of the authors and are not to be construed as reflecting the views of the Navy Department.

Discussion of Paper on Explanation of the Titration Values Obtained in the Merriman Sugar-Solubility Test for Portland Cement[1]

MR. N. T. STADTFELD.[2]—In his recognized thorough manner the author has done an excellent job of investigating the various factors affecting the solubilities of portland cements in the Merriman sugar-solubility test. The results obtained are interesting and of value for better understanding of the reactions involved.

There would be little reason for criticism were it not for the following two statements:

"Mr. Merriman was of the opinion that the test served as a measure of the completeness with which the cement had been processed, that it would detect clinker which had been underburned and would also detect whether a well-made clinker had been spoiled by the addition of water or by conditions of storage," to which statement he does not return and further on

"It is not within the scope or purpose of this paper to consider the other items in which the specifications of the New York Board of Water Supply differ from those of the A.S.T.M."

It is unfortunate that the author has deemed it beyond the scope of his article to consider the other items of the Board of Water Supply Specifications closely related to the sugar test. One is reminded somewhat of the case of the medical student who, in an examination, was to discuss the liver but being not too familiar with the subject started out by stating that the liver must not be confused with the heart, for which organ he then wrote an excellent dissertation.

Mr. Merriman was too much of a scientist to consider the sugar test as being of equal value in all cases. It is definitely tied up with kiln temperature control, minimum silica content of 21.5 per cent, maximum alumina of 5.6 per cent, an alumina over iron ratio of 1.20 to 1.60 and fineness limitations both ways. Moreover, and here is where the liver and the heart come in, the SO_3 content is limited to 1.75 per cent which meant that in practice it did not exceed 1.60 per cent, thereby bringing the author's investigation outside the scope of conditions under which the sugar test is applied.

It is here reiterated that Mr.

[1] William Lerch, "An Explanation of the Titration Values Obtained in the Merriman Sugar-Solubility Test for Portland Cement," ASTM BULLETIN, No. 145, March, 1947, p. 62.

[2] Division Engineer, Board of Water Supply City of New York, New York, N. Y.

Merriman was perfectly right in his opinion that the test serves as a measure of the completeness with which cement had been processed. This statement is based on practical experience obtained during the making of 7 million barrels of Board of Water Supply cement. Continuous high kiln temperatures were necessary as can be verified by the thousands of records on hand obtained at the ten plants which made this cement.

Let us not cloud the issue. This cement has uniformly produced concrete of a quality such as was not obtained heretofore. When it is considered how many concrete structures are still suffering for one reason or another one cannot help but admire Mr. Merriman's genius, especially in view of the statement in a private communication to me by one of the officials of the Bureau of Reclamation that Parker Dam would not now be in distress if Board of Water Supply cement had been used in its construction.

The ten-year record of over $3\frac{1}{2}$ million cubic yards of concrete placed in tunnels, retaining walls, aprons, large buildings, aerator basin covering acres has not revealed a single failure, nor has there been evidence of the presence of laitance even in 20-ft. lifts. Our field practice has changed but little during the years, our aggregates hardly at all, but our structures built with this cement are outstanding compared to the miserable failures obtained in much of our previous work. It all has worked out as Mr. Merriman predicted, due to the specifications which he wrote of which temperature control in the kiln room and the sugar test are two revolutionary and integral characteristics.

The author refers to the article in *Rock Products*, Vol. 43, No. 10, p. 46, October, 1940, but neglects to mention my answer defending the Merriman sugar test in *Rock Products*, January, 1941, p. 62. It is inconceivable that, thorough student as he is, the author is unfamiliar with it. From this article the following is quoted:

"Results of an experiment carried out at one of the mills, where temperatures of the burning zone were carefully controlled, should dispel all doubt as to the relation between sugar test and burning temperatures. On several successive days the normal product of this plant was made, the only variable being kiln temperature. This was varied until the maximum difference was 135 F. Cement made from clinker obtained at the highest temperature showed a sugar solubility of 2.1, that at the lowest, 56.0. This evidence is not easily refutable."

Here is a simple test which may be carried out at any cement plant. With the enormous resources of the Portland Cement Association behind him it should have been easy for the author to duplicate this experiment thereby checking for himself Mr. Merriman's contention without leaving it up in the air as he does now. Why should this not have been done and the results published?

A few detailed remarks regarding the author's results are now in order.

The accompanying Table I shows characteristics of cement contained in one of the 5000-barrel silos picked at random and filled with B.W.S. Specification cement. Samples were taken from the mill stream between the finishing mills and the silo by means of an automatic sampler. Each sample represents 400 barrels of cement.

TABLE I.—INFLUENCE OF SHAKING TIME ON THE TITRATION VALUES IN THE SUGAR-SOLUBILITY TEST.

Sample Number	SO_3 Content, per cent	Titration Values, ml. of 0.5 *N* HCl Clear Point		
		2 hr.	4 hr.	5 hr.
1	1.17	2.2	2.5	2.6
2	1.10	2.4	2.5	2.7
3	1.32	2.6	2.8	3.0
4	1.41	2.5	2.5	2.7
5	1.47	2.7	2.7	3.0
6	1.51	2.5	2.8	3.1
7	1.55	2.6	2.7	2.8
8	1.47	2.4	2.6	2.7
9	1.46	3.0	3.2	3.6
10	1.47	2.7	3.0	3.1
11	1.50	2.7	3.0	3.2
12	1.39	2.6	2.8	3.0

This table indicates that for cement made with a well-burned clinker a shaking time of 5 hr. shows but little increase in titration values compared with a shaking time of 2 hr. The author found the same results for one of his cements, namely 43A-224. Had he told us the history of this cement, specifically how well the clinker was burned, the test would have been of greater value. As far as our clinker is concerned, this result is normal.

To look somewhat deeper into the author's claim as to the influence of gypsum on the titration values the following test was run. A sample of fresh clinker obtained during the filling of the same silo mentioned above was ground in a laboratory ball mill to a fineness where it all passed the No. 200 sieve and 1.5 per cent was retained on a No. 325 sieve, which ought to be fine enough for anybody, the specific surface being 2920 g. per sq. cm. One half of the sample was used without gypsum, the other half had 3 per cent $CaSO_4 2H_2O$ by weight added to it. The sugar test was run in triplicate on each sample, the SO_3 content in per cent determined before the sugar test and the SO_3 content in grams per liter determined in the extract after the 2-hr. shaking time in the sugar test. Table II gives the results of this test.

TABLE II.—THE EFFECT OF THE ADDITION OF GYPSUM TO FINELY GROUND CLINKER ON THE TITRATION VALUES.

	SO_3 Content Before Sugar Test, per cent	SO_3 Content in Extract, g. per liter	Titration Values, ml. of 0.5 *N* HCl
Ground clinker	0.10	0.16	2.2
Ground clinker + 3% $CaSO_4 2H_2O$	1.55	0.80	2.4

This is by no means an isolated case. In fact one of the cement companies, in testing the clinker for the sugar test before grinding, did not bother to add gypsum in this preliminary test, knowing full well that the addition of 3 per cent gypsum would not save an underburned clinker. The author states on page 64: "These results give further evidence that gypsum dissolved in the sugar solution depresses the solubility of the cement and that it is not until after the gypsum becomes depleted that a high solubility occurs." But what happens to this theory when there is no gypsum? It falls to pieces, as it should, for the sugar test properly applied "does serve as a measure of the completeness with which the cement has been processed" as Mr. Merriman stated.

And just where does this leave the author? Exactly at the point where other investigators have stood, who started in the middle of the problem with a clinker or a cement the burning history and storage history of which were unknown.

The results shown in Tables VII and VIII showing the effect of either quick or slow cooling of the clinkers on the sugar value are interesting. We are dealing here with a clinker which is most unusual in that it contains no free lime whatsoever. In all my experience I have never seen this accomplished in commercial practice nor do I know of any cement company which could afford to let clinker cool slowly in the kiln. The terms "quick" and "slow" cooling are relative. While some companies apply rapid air cooling and others use a slower method the extremes are not as great as in the author's tests. Staying within these limits it is not considered possible to have an underburned clinker pass the sugar test by quick cooling nor to have a well-burned clinker (as indicated by consistently high kiln temperature) fail in the test by slow cooling.

One may well wonder why we keep living in a dream world of unreality with artificially made and cooled clinker, when there is so much real evidence to be had from a commercially made and controlled product.

In closing let me state that I am concerned only with the deeper purpose of the A.S.T.M., which must be the obtaining of materials suitable for their intended use. Voltaire is quoted as having said: "Speech was given to man so he may hide his thoughts." One might also say that scientific investigations may hide fundamental truths.

In the present agitation for air-entraining cement which, as formerly other theories were intended, is now to cure our ills, a single small voice may not be amiss with the statement that the secret of suitable cement for durable concrete still lies in the kiln room and on this process the Merriman sugar test, when properly applied to fresh samples adhering to chemical and physical properties set down in the Board of Water Supply Specifications, forms a valuable control.

MR. WILLIAM LERCH (*author's closure*).—The discussion by Mr. Stadtfeld has been read with interest. It contains some points that deserve further comment. In the first place it must be clearly understood that the paper was written for the purpose of giving an explanation of the titration values obtained in the sugar-solubility test on the basis of the chemical reactions involved in the test. It was written as a scientific dissertation and without bias. The author, like Mr. Stadtfeld, always had the highest regard for the late Mr. Merriman and his scientific integrity. In fact he held him in such high regard as to believe that Mr. Merriman recognized that research was dynamic and not static, and that opinions expressed today could be modified or revised on the basis of new information obtained tomorrow. Both Mr. Merriman and Mr. Stadtfeld deserve great credit for the good concrete that has been placed under their supervision.

Mr. Stadtfeld cites the following statement from the paper: "Mr. Merriman was of the opinion that the test served as a measure of the completeness with which the cement was processed, that it would detect clinker which had been underburned and would also detect whether a well-made clinker had been spoiled by the addition of water or by conditions of storage." He says the author did not return to this statement. As a matter of fact, the major portion of the paper was devoted to this statement. The major part of the tests described in the paper were made on cements prepared from four different samples of clinker. The conditions of burning and storage of the clinker remained the same. In the sections discussing the effect of fineness, effect of gypsum, effect of free lime, effect of sodium carbonate and effect of shaking time, it was shown that each of these had a pronounced effect on the titration values obtained in the sugar-solubility test. When the results of all these tests were plotted, Fig. 1 of the original paper, there was a definite relationship between the clearpoint titration values and the SO_3 content of the extracts.

The paper was confined to a discussion of the sugar-solubility test *per se* and it was not within the scope of the paper to consider the other items in which the specifications of the New York Board of Water Supply differ from those of the A.S.T.M. Mr. Stadtfeld considered this was unfortunate. However, it was believed that an understanding of the factors affecting the titration values would be a useful guide in interpreting the significance of the test. In this connection it should be recalled that the A.S.T.M. Committee C-1 has Working Committees on Strength, Methods of Chemical Analysis, Time of Setting, etc. Each of the working committees does study and discuss the merits of these individual items in the specifications for cement.

Mr. Stadtfeld cites the results of an experiment carried out at one mill where the temperatures of burning zone were varied under carefully controlled conditions. Cement made from clinker obtained at the highest temperature showed a sugar-solubility test of 2.1, that at the lowest, 56.0. The Portland Cement Association has made extensive studies of the effect of temperature on the completeness of combination of lime.[3] In these studies the free lime test was used as a direct quantitative measure of the completeness of combination. The test has been included in A.S.T.M. Methods C 114 – 46.[4] In the paper under discussion it was clearly demonstrated that lime dissolved in the sugar solution, whether derived from the free lime in the cement or lime added to the cement, does tend to give high titration values. Furthermore, this observation was fully explained. Lime dissolved in the sugar solution accelerates the reaction of gypsum with the calcium aluminates and it is only after the gypsum becomes depleted that high titration values are obtained.

Mr. Stadtfeld cites a case where a clinker ground without the addition of gypsum gave low titration values. The author has obtained similar results, but since the test was proposed for use in specifications for cement that contained gypsum, it did not appear necessary to discuss the results obtained with clinker. However, since the question has been raised a brief explanation seems to be in order. The clinkers that gave low titration values were those of low $3CaO.Al_2O_3$ content. In a previous paper it was shown that

[3] W. C. Hansen and R. H. Bogue, "Combination of Lime in Portland Cement Compounds," *Industrial and Engineering Chemistry*, Vol. 19, p. 1260 (1927).

[4] Standard Methods of Chemical Analysis of Portland Cement (C 114-46), 1946 Book of A.S.T.M. Standards, Part II, p. 17.

some clinkers of low $3CaO.Al_2O_3$ were practically inert to hydration for as much as eight hours when ground without gypsum. It would be expected that such inert material would have low titration values in the sugar-solubility test. The addition of gypsum accelerated the hydration of these clinkers. The same clinkers when ground without gypsum were slow setting, had low early strengths and high contraction on drying. It is not likely that Mr. Stadtfeld would be interested in using such materials for cement.

Although it has no connection with the paper under consideration, Mr. Stadtfeld seems critical of the present agitation for air-entraining cement which "is now to cure our ills." It is not to be expected that air-entraining cement will insure durable concrete unless it is used with good aggregates and good workmanship. However, if Mr. Stadtfeld would examine some of the pavements constructed with air-entraining cement in New York and neighboring states, it is likely that he would conclude that air entrainment does have its merits. He would also see good concrete that was made with cements that did not meet either the requirements of the sugar-solubility test or the other items in which the specifications of the New York Board of Water Supply differ from those of the A.S.T.M.

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* William Lerch, "The Influence of Gypsum on the Hydration and properties of Portland Cement Pastes," *Proceedings*, Am. Soc. Testing Mat. Vol. 46, p. 1254 (1946).

Betatron Research in Multimillion Volt Range

PLANS have been completed at the National Bureau of Standards for the erection of two betatrons, enabling scientists here to extend research, measurements, and standards development into the 50 and 100 million volt range.

Two immediate problems calling for extensive investigation are the determination of measurement techniques and the formulation of precautionary principles in the use of the betatron for cancer treatment.

For the past twenty years, the National Bureau of Standards has played a central role in the development of standards for X-ray dosage measurement and protection. The field has been covered thus far only up to one and a half million volts. For this purpose, the Bureau now has one of the best equipped X-ray laboratories in the world. Because of its facilities and its experience in the field of radioactivity as well as X-rays, outside organizations such as the radiological and medical groups, the Manhattan District, and the International Commission of Radiation Protection and Radiation Dosage, are looking to the National Bureau of Standards for extension of X-ray measurement activities into the newly opened multimillion volt range.

The betatron is a device for producing electrons or X-rays of extremely high energies and frequencies. Both as an X-ray device and as an electron beam generator, the betatron has unusual potentialities in the fields of medical, bilogical, in lustrial, and nuclear research.

It consists essentially of a large alternating-current magnet, in the center of which is an evacuated tube having a doughnut shape. Electrons are admitted into this tube, where they describe a circular orbit under the influence of a magnetic field, making hundreds of thousands of revolutions in a fraction of a second. When these energized electrons strike a target within the tube, extremely penetrating X-rays are produced. The tube may be arranged so as to emit electrons directly, and electron beams having a range of several feet may be produced in air.

As a medical tool, the betatron can provide X-rays suitable for cancer treatment under conditions long dreamed of but never realized.

During the war, the betatron came into limited industrial use for the inspection of heavy matel objects such as guns, shells, and large castings. Photographic exposures could be made through a foot or more of steel in a matter of seconds, using a betatron, whereas the older methods utilizing radium required hours.

The problems of protection in both the medical and industrial applications of high-voltage radiation are immeasurably greater in the multimillion volt range than in the lower regions heretofore encountered. Heavy protective barriers and expensive over-all installations are required, but the exact protection measurements and techniques are as yet unknown. One of the aims of the Bureau study is to discover the necessary thicknesses and types of construction that will give maximum protection with lowest over-all costs. Industrial use, in particular, presents difficulties not encountered in the medical applications, and the establishment of safe working conditions for industrial betatron use is one of the principal objectives.

The betatron is also an important tool in nuclear or atomic research. Many nuclear transformations are brought about simply by exposing materials to the powerful X-ray beam. It is planned to make a systematic study of these transformations, which constitute a phase of atomic research virtually untouched at present.

Some of these transformation processes may take place when the human body is exposed to radiation, and it therefore becomes essential that they be thoroughly understood in connection with any biological or medical experiments. An understanding of these processes will also contribute materially to our understanding of the general atomic picture.

In 1946 Congress authorized and appropriated funds for the construction of a special building and the installation of a betatron at the Bureau.

The betatron was designed to operate up to 50 million volts, although the building was designed to house much larger equipment as it became available, equipment up to 150 million volts and probably higher. While the building designs have been completed by the Public Building Administration, the program has been retarded by the sharp increase in building costs since the appropriation estimates were made. The action of Congress is awaited before proceeding with the construction program.

The main chamber in which the betatron is to be housed, and the X-rays produced, will be completely buried underground and covered by several feet of concrete and earth. This is to prevent any direct radiation from escaping and harming nearby workers.

The sensitive measuring equipment will be housed in an adjoining smaller room. In combination with these two rooms, facilities have been designed for determining the protective values of concrete and other materials, under conditions that will permit of their broad interpretation in the medical and industrial X-ray field.

This latter point is of particular importance, since it is almost impossible to obtain this information with any of the existing or contemplated betatron installations. Requirements for this work are such that the buildings must be specially designed and constructed just for the purpose of determining protective values. The operators of the equipment will be separated from the betatrons by a concrete labyrinth and a five-foot thick concrete wall, operating all equipment by remote control devices.

The first betatron called for will operate up to 50 million volts. Although this is not the largest device available, it is essential to provide for the production of X-rays from the low voltage of 1 million up to the higher 50 million volts. The region between 1 and 20 million volts is of extreme importance in medicine and biology.

Large instruments, unfortunately, cannot operate successfully in this lower range.

The 1947 budget request calls for the addition of a 100 million volt betatron which will enable the Bureau to extend its studies above the 50 million volt limit of the smaller instrument. It is in this higher region that atomic and nuclear phenomena begin to become more evident.

Broad cooperative programs of research are planned with the National Cancer Institute and the Carnegie Institution of Washington. The National Cancer Institute has excellent facilities for biological investigation, while the Carnegie Institution has available both a cyclotron and a Van der Graff generator. Acquisition of betatron facilities by the National Bureau of Standards, in conjunction with its established radioactivity and X-ray laboratories, serves to round out the biological, medical, and biophysical radiation facilities of the Washington area in the high energy radiation range.

Electronic Timer for Viscosity Measurements

ANNOUNCEMENT has been made by the National Bureau of Standards of the design by P. J. Franklin of a new electronic timer, particularly adapted for use with a falling-ball viscosimeter in the study of the rapidly changing viscosity of an opaque fluid. The device consists of pulse sharpening and trigger circuits, and the passage of the ball through two coils around the viscosimeter tube is used to trigger a radio frequency oscillator, starting and stopping a timing device.

By the falling-ball method, a closed tube, surrounded by a constant-temperature jacket and containing a ball immersed in the liquid to be studied, is quickly inverted; and the viscosity is determined by accurate timing of the rate of descent of the ball through the liquid, which accuracy the electronic timer provides. The method is very useful for viscosity measurements in the production of paints and lacquers where the instrument must be enclosed to prevent evaporation of volatile solvents, and in the oil and asphalt industries, where the opacity of the liquids involved makes non-visual timing a necessity.

A comparatively simple circuit was developed for the timer, making use of the radio frequency induction field. Various electrical methods employing the conductive or magnetic characteristics of the falling ball had been used previously to measure its time of travel, but none was considered completely satisfactory due to lack of sensitivity, poor reproducibility of results, or the complicated nature of the circuit required. The induction method used in the recently developed timer seems to be the answer to the problem.

An Indentation Method for Measuring Wear[1]

THE National Bureau of Standards recently reported investigations conducted under S. A. McKee leading to the adaptation of a diamond indentation method of measuring wear of machinery surfaces, and resultant development of a sensitive measuring instrument, the McKee Wear Gage, to measure extremely small increments of wear, as little as one hundred-thousandth of an inch under favorable conditions—considerably less than with other methods. By applying to the working surfaces narrow diamond-shaped markings that show a definite change in one or more readily measurable dimensions after relatively small amounts of wear, the gage provides a determinable indication of wear at the point where the marking is made.

Extensive tests proved that this method overcomes the shortcomings of the weighing and measuring methods which although giving a value for total wear do not indicate where the wear occurred, and the latter does not differentiate between actual wear and other changes such as growth, shrinkage, or distortion of the part. The method of determining the amount of worn material in the lubricant after operation also has presented numerous difficulties. Furthermore, with the indentation method the accuracy is not materially affected by temperature variations.

The McKee gage was designed primarily to locate and measure indentation marks on the cylinder walls and pistons of radial aircraft engines, since permanent distortion of such parts during operation had heretofore nullified the significance of any previous methods of measurement. The choice of the type of mark was influenced by an earlier development at the Bureau—the Knoop indenter for measuring the hardness of materials.

In addition to its use as a practical method of measurement of wear in aircraft and automotive engine cylinders, the indentation principle appears applicable to other machine elements, gages, dies, and wearing surfaces where the material is of such a nature that the indented marks will retain their shape in service. For example, a mark placed on the wearing surface of certain production dies would readily indicate when it had been worn beyond specified tolerances.

[1] Developed at the National Bureau of Standards by S. A. McKee at the suggestion of and with collaboration of Dr. H. C. Dickinson. The method is covered by U. S. Patent No. 2,233,403, granted to Dickinson and McKee and assigned by them to the United States Government.

Moisseiff Award

THE AMERICAN Society of Civil Engineers has established an annual award in honor of the late Leon S. Moisseiff, New York consulting engineer and prominent authority on bridges and related structures. The award consists of a bronze medal and a certificate which will be made for an important paper published in the ASCE *Transactions* "dealing with the broad field of structural design, including applied mechanics, as well as the theoretical analysis, or constructive improvement, or engineering structures such as bridges and frames, of any structural material." Mr. Moisseiff was for many years an A.S.T.M. member and participated in the work of various technical committees.

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